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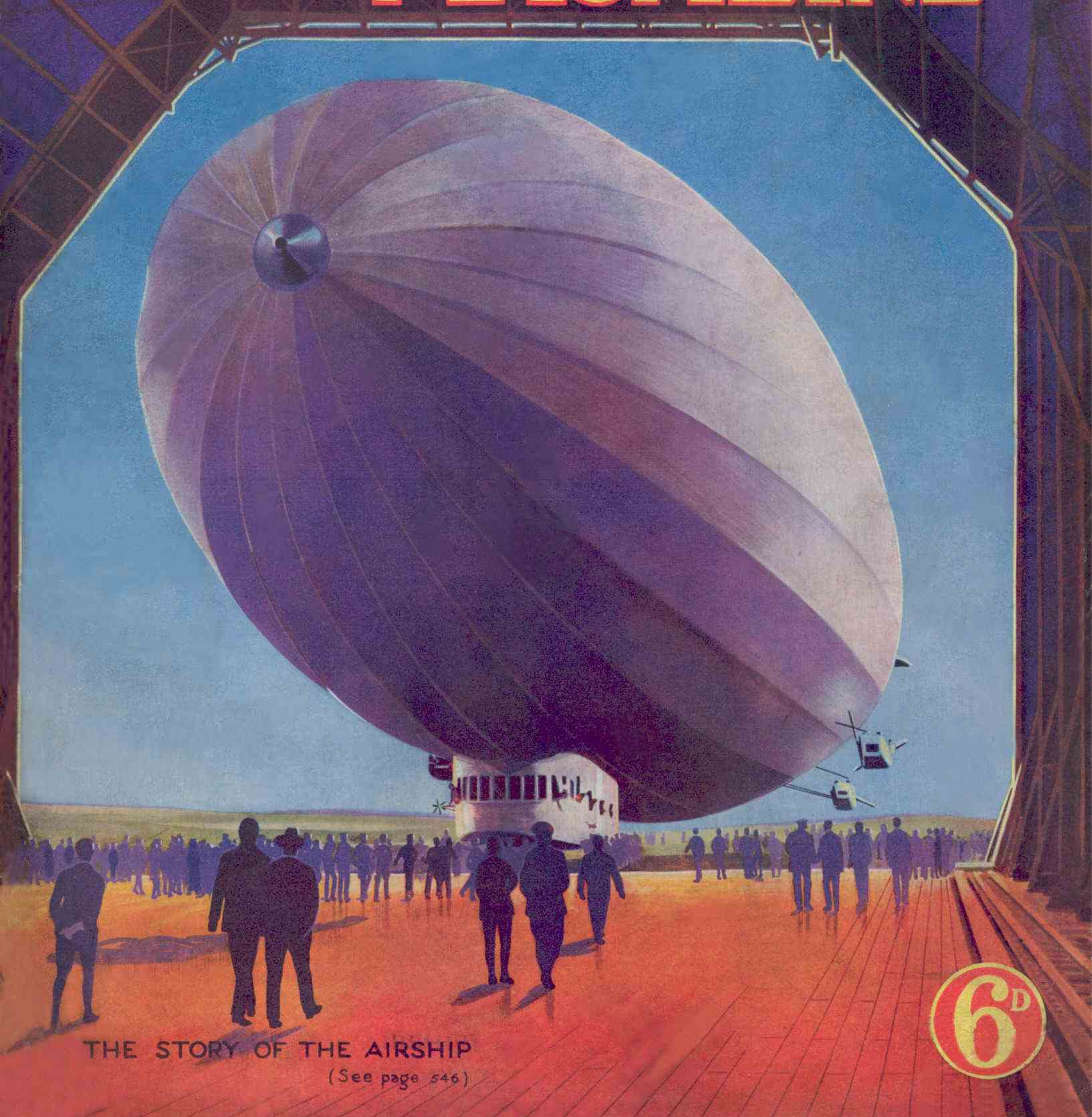
MECCANO MAGAZINE



THE STORY OF THE AIRSHIP

(See page 546)

6D

You can't have a real holiday without a MISS AMERICA

There's nothing like it for endless fun on any yacht pond. No trouble and no danger. Just put water in the boiler and meth. in the lamp and after a few minutes—whirr-r-r-r—off goes the little engine ready to drive the boat right round the pond. You can set the rudder to make it go where you like. One filling drives the boat for 20 minutes at a steady speed. There's real joy in oiling up, tuning up and running such a sturdy boat. She's full of beans, and is as good as she looks. There are thousands of happy lads with them now—you'll see them round any yacht pond.

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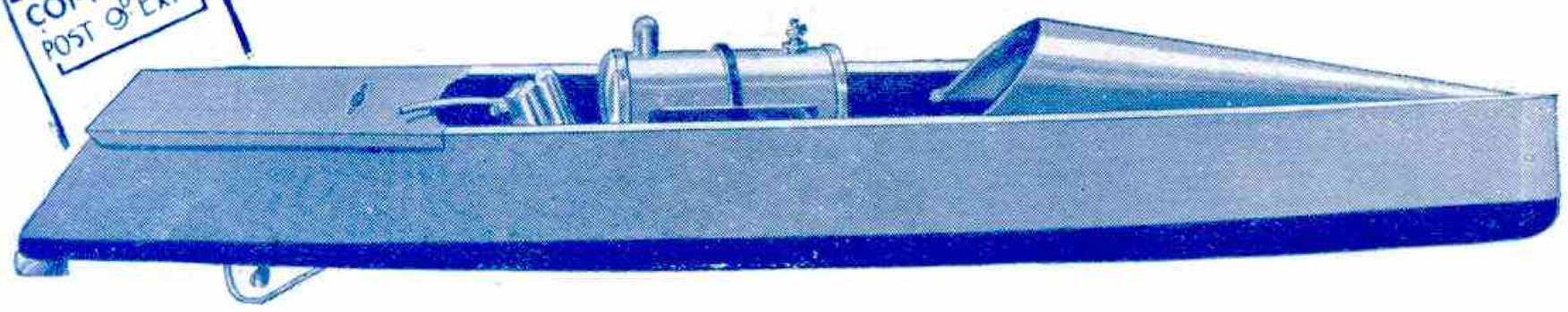

The boat is built of well seasoned timber with a properly balanced hull, 26½ ins. long and 4¼ ins. beam. The engine is of polished brass, oscillating type with all parts accurately machined and fitted. A safety valve is fitted to the boiler and the lamp reservoir is carried away from the actual flame. The propeller is twin bladed, fitted with a guard, behind which is the rudder. A short deck is provided aft, and forward is a spray hood. The boat is supplied in a strong box with lamp, filler and full instructions how to run.

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A realistic boat, fitted with funnel and mast. Nearly 30 ins. long. Sturdy engine with direct drive. Complete with instructions 11/9, Postage 9d.

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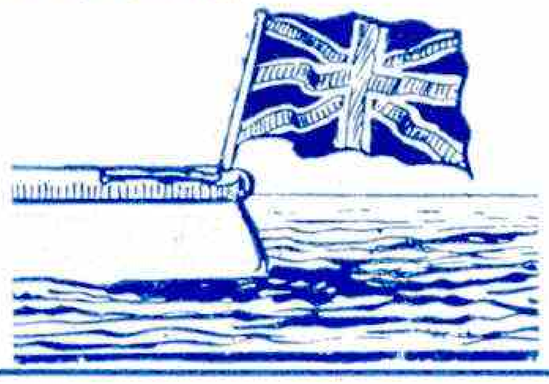
The master boat of all. A beautifully finished hull 31½ ins. long, with two colour water line. The engine has a superheated boiler greatly increasing the power and speed. The whole engine can be taken out to drive stationary models, and a special gear and grooved pulley is provided for this purpose. Fitted with automatic drip feed and supplied in wooden box with filler, measure, and full instructions. Price 30/- or 31/3 post free.



HOBBIES

Ask for Miss America at any toyshop or stores or see one at Hobbies Branches in London, Glasgow, Birmingham, Manchester, Leeds, Southampton, Sheffield, Brighton. Orders can also be sent by post to Dept. 198, Hobbies Ltd., Dereham, Norfolk. Canadian Depot—385½ Yonge St., Toronto, Ontario.

MECCANO MAGAZINE

Editorial Office
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Liverpool

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With the Editor

Does the Sea-Serpent Exist?

Some things appear in our newspapers with unfailing regularity at certain times of the year, and during this so-called "silly season" the sea-serpent is sure to make its appearance. Year by year the question of the existence of this historic beast is debated and always we come to the same conclusion—that nobody knows! The monster usually reveals itself only in deep seas but it is recorded as having been seen from the shore of the south and east coasts of England, and on one occasion at least in the comparatively shallow water between the Isle of Skye and the Scottish mainland. Amateur photographers therefore should keep a strict lookout for a chance to earn undying fame by securing a photograph. Only one man appears to have been lucky enough to have had a camera in his possession when he encountered the sea-serpent, and evidently he was not a Meccano "boy" because he became so excited that he forgot to use it!

One often hears people suggest that the sea-serpent is merely a production of the newspapers, to provide something exciting for their columns at a time when sensational news is often very scarce. These people forget that the creature's history goes back long years before bank holidays or daily newspapers were even thought of.

It would be very interesting to have the evidence for and against the existence of the sea-serpent considered solemnly in a court of enquiry. The witnesses in its favour would include two bishops; several doctors; the officers and crews of two warships of 70 years ago; the members of a scientific society; and a very large number of officers and men of sea-going vessels of all types. One man saw it from a lighthouse on the coast of South Africa and tried to shoot it, but although he fired several shots he missed each time. Then, unfortunately, something went wrong with the mechanism of the rifle and the sea-serpent promptly disappeared! The scientific society mentioned above was the Linnaean Society, of Boston, U.S.A. As a result of reports from fishermen that the sea-serpent had been seen off the coast of Massachusetts, the society appointed a committee to select and sift the evidence. Their report expressed the opinion that the evidence was trustworthy and a month later the society actually received for dissection a young sea-serpent alleged to have been caught on the shore. To this new type of sea creature they gave the high-sounding name of *Scolioplus-Atlanticus!*

The officers and crew of one vessel, the "*Pauline*," which crossed the path of *Scolioplus-Atlanticus*, attempted to place the matter on a legal footing, for they made declaration on oath before the stipendiary magistrate of Liverpool that they had witnessed a great fight between a large sperm whale and a serpent that they estimated to be about 160 ft. in length. There was no doubt in their minds about the existence of the serpent and if their evidence is to be believed there should be none in ours, for they distinctly saw that the body of the whale was in the grip of two coils of the monster. Its head and tail was about 30 ft. in length, and the death struggle continued before the eyes of the crew for about 15 minutes before the whale was finally vanquished and dragged down to the depths. Several of the witnesses of this fight declared that they saw the same—or, at any rate, a similar—serpent a few days later.

The detailed account given by the crew of the "*Pauline*" seems to dispose of the usual suggestions that those who claim to have seen a sea-serpent have really been misled by seeing a string of gambolling porpoises, or a long line of floating seaweed. There also arises another important point—that most of the stories of the existence of the creature have come from sailors, who were accustomed to seeing whales, and therefore were not likely to be mistaken in identifying what they saw.

In the present state of our knowledge it would be foolish to deny the possibility of the existence of the sea-serpent. It is quite possible that among the inhabitants of the sea are creatures of a kind still unknown to science. In the insect world new species are being discovered constantly and there is no reason to believe that we have an exhaustive knowledge of any other branch of natural history. It has been suggested with some reason that creatures of a prehistoric type may still linger on in the great forests of Africa and Brazil, and similarly that a few specimens of prehistoric marine reptiles may still be living in the depths of the ocean. Possibly the question may be settled when methods of exploring the sea floor have been further developed and we are able to secure a more accurate census of the ocean population. It is to be hoped that the investigators of the future will secure photographic records or produce actual specimens, dead or alive, of genuine sea-serpents. Otherwise they may find themselves included among the "credulous sailors, imaginative landsmen and common liars" who are, according to a well-known dictionary, the only people who have ever seen the monster!

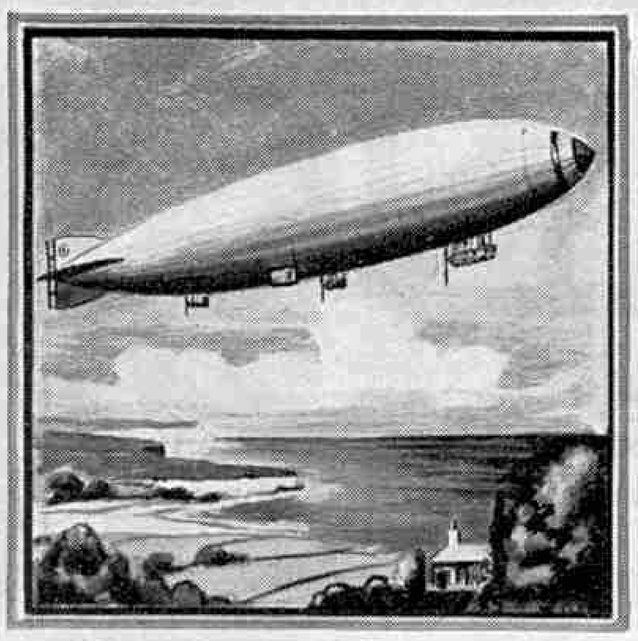
ARE YOU IN DOUBT?

If so, write to the Editor and he will do his best to solve your problem, or to help you with advice. Mark your letter "Special."

Taking Holidays Seriously

As I write, the sun is pouring into my room and the heat is so intense as to make me think longingly of a holiday and seaside breezes. The thought of what my 100,000 (and more!) readers would do to me if the next number of the "*M.M.*" failed to appear on the appointed date makes me still hotter, however, and I realise that I must remain in Liverpool until this issue is complete. Then I may tear myself away for a few days—only to rush back to tackle the next number!

I often wonder whether we take our holidays seriously enough. As at school or at work we make the utmost of every minute of the time, surely we should do exactly the same with our holidays. I do not mean that we should rush and tear about or play strenuous games all day long, but that we should try to extract the last ounce from every hour of our holiday. The best thing a summer holiday affords is an ample supply of fresh air and sunshine. We have heard a good deal recently about the wonderful healing effects of artificial sunshine—a very valuable substitute for, but not to be compared with, the real thing. During our summer holiday real sunshine is at our disposal without any elaborate apparatus or instruments and free of charge. My advice to all readers is this—having earned your holiday take care to enjoy it thoroughly. Forget all about your work for a while; put on one side even your beloved Meccano Outfit or Hornby Train, and spend every possible minute out in the open, absorbing health and strength with every breath you draw.

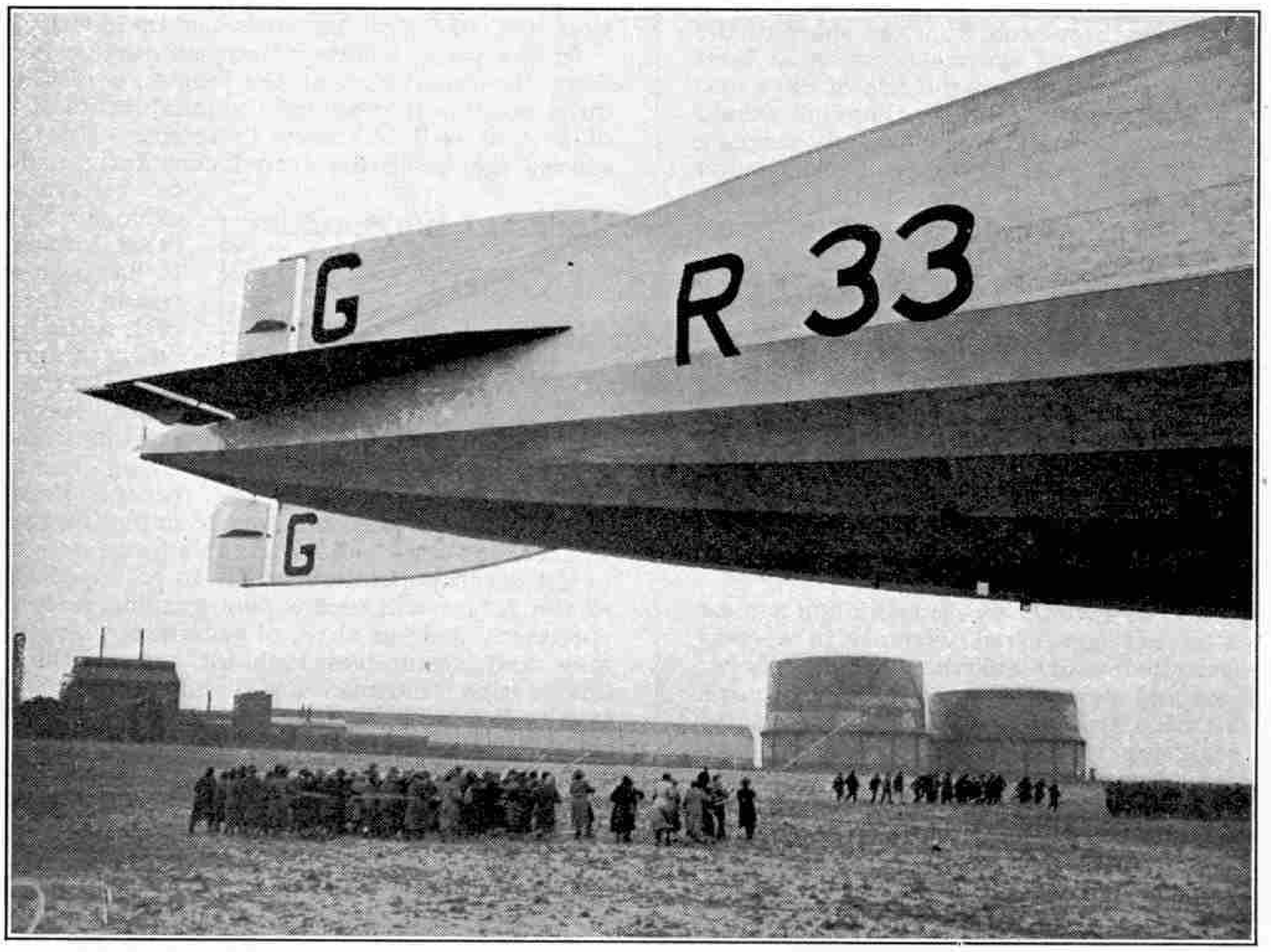


The Conquest of the Air

DEVELOPMENT OF THE DIRIGIBLE

LAST month we described the construction of the British rigid airship R.34, and now we come to the historic flight across the Atlantic and back again made by this vessel in 1919. It was originally intended that the voyage should be "non-stop," but so great was the American interest in the project that it was finally arranged that the airship should remain in the United States for a few days before making the return trip to England. This having been decided, an advance party consisting of two officers and eight men was despatched to the United States to arrange for the provision and erection of a suitable mooring tower.

The flight began early in the morning of 2nd July, 1919. Twenty minutes after emerging from her shed at East Fortune, Scotland, the great airship was aloft, having on board a fuel supply of 4,900 gallons of petrol weighing 15.8 tons, and a specially selected crew of 32 with Major Scott in command. A 20 m.p.h. easterly wind was blowing and a misty rain falling at the time, and when only 1,000 ft. up the airship vanished above the low-lying clouds. At 1,500 ft. she re-appeared momentarily and was seen flying toward Edinburgh. Soon the western shore of Scotland was left behind, the northern coast of Ireland seen and passed, and the great expanse of the Atlantic opened out ahead.



The R.33 leaving the Aerodrome at Cardington, near Bedford

The crew were relegated to four-hour turns of duty, while a useful "odd-job man" turned up in the person of a young stowaway who was found hiding amid the girders soon after the start of the flight. When he was discovered and hauled before the senior officer he was recognised as a mechanic who had begged to be included among the crew but whose application had been refused. By the time his presence became known it was impossible to drop him anywhere and he was therefore accommodated with the crew and as much use made of his services as possible.

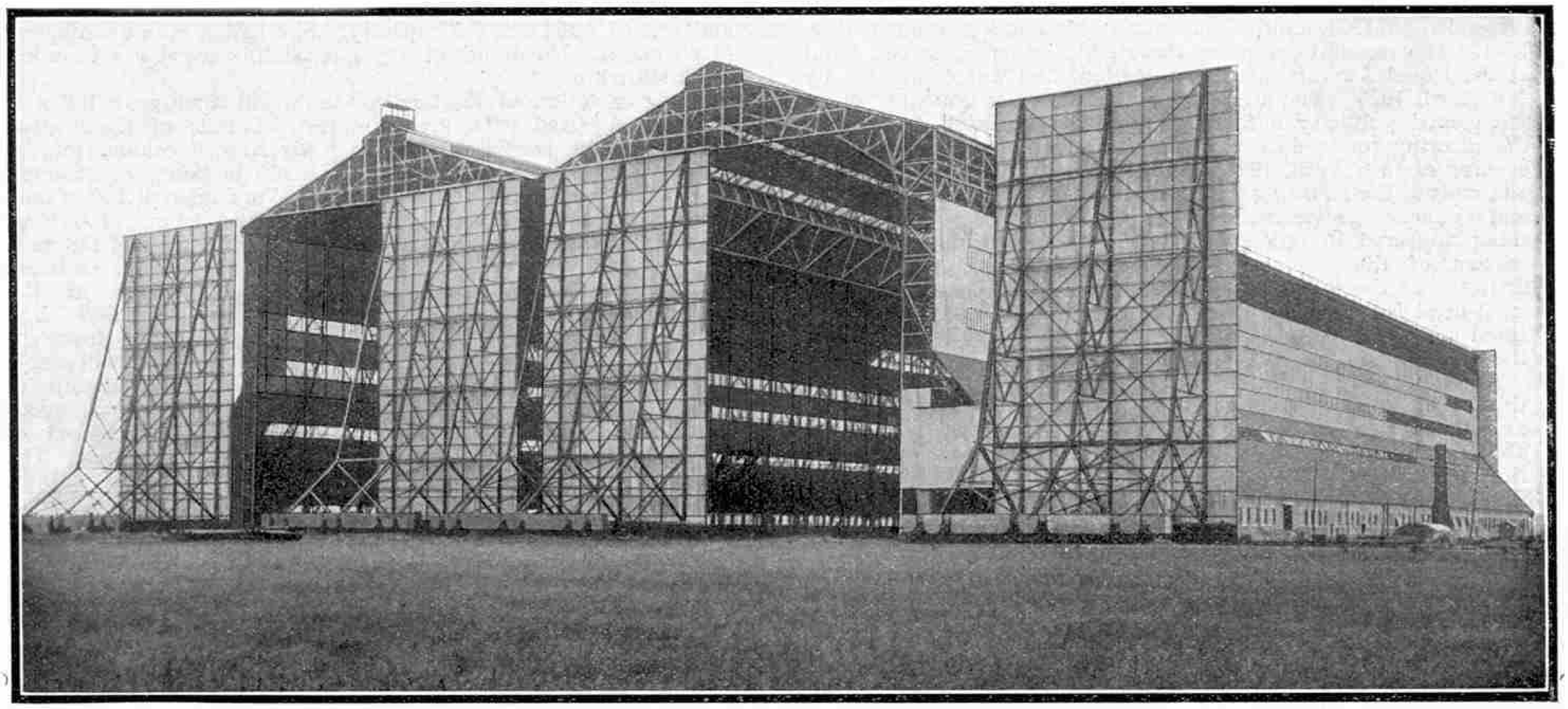
During the greater part of the outward trip the R.34 flew at an altitude of 1,500 ft. and for a considerable period the crew had the strange experience of flying between two dense layers of clouds. Occasionally a rift in the bank of billowy vapour below gave them a glimpse of the sea, or a break in the cloud bank above gave them a brief sight of the sky. As they approached the Newfoundland coast they passed over innumerable icebergs. Dense fog was encountered as they passed over Newfoundland and they descended to 800 ft. in order to get their bearings. They were still 500 miles from their destination, and as Major Scott was becoming doubtful as to whether their supply of fuel would last out, he communicated by wireless with the United States authorities requesting them to despatch a destroyer to take the airship in tow. Happily this emergency measure proved unnecessary.

After the fog they encountered a severe thunderstorm, but eventually arrived safely at Long Island, New York, where a considerable landing party directed by United States airmen gave them a great welcome and assisted in anchoring the airship. The total time taken in making this momentous trip from East Fortune to Long Island, a distance of 3,520 miles, was 108 hours 12 mins.

The weather did not improve much during the airship's sojourn on U.S. territory. On the evening of the 9th July, 1919, Major Scott decided to avail himself of the strong south westerly wind then blowing, and the crew were ordered to be at their posts at 10.30 p.m. that night. The gas-bags of the airship required partial re-inflation and this task was in hand almost up to the last moment. Hurried farewells were said to the many new friends the crew had made during their brief stay, the last of the necessary provisions were taken on board, the roll was called and a few minutes before midnight the airship was released. Although only three of the five engines were started up the airship rose quickly to a height of 2.000 ft. and headed toward New York.

News of the airship's departure had been flashed to New York immediately and naturally aroused the greatest interest. One of the officers of the R.34 in describing her passage over the great city wrote that "New York at midnight looks wonderful from above. Miles and miles of tiny twinkley lights—a veritable fairyland. We see thousands of upturned faces."

The return trip to England was accomplished in improving



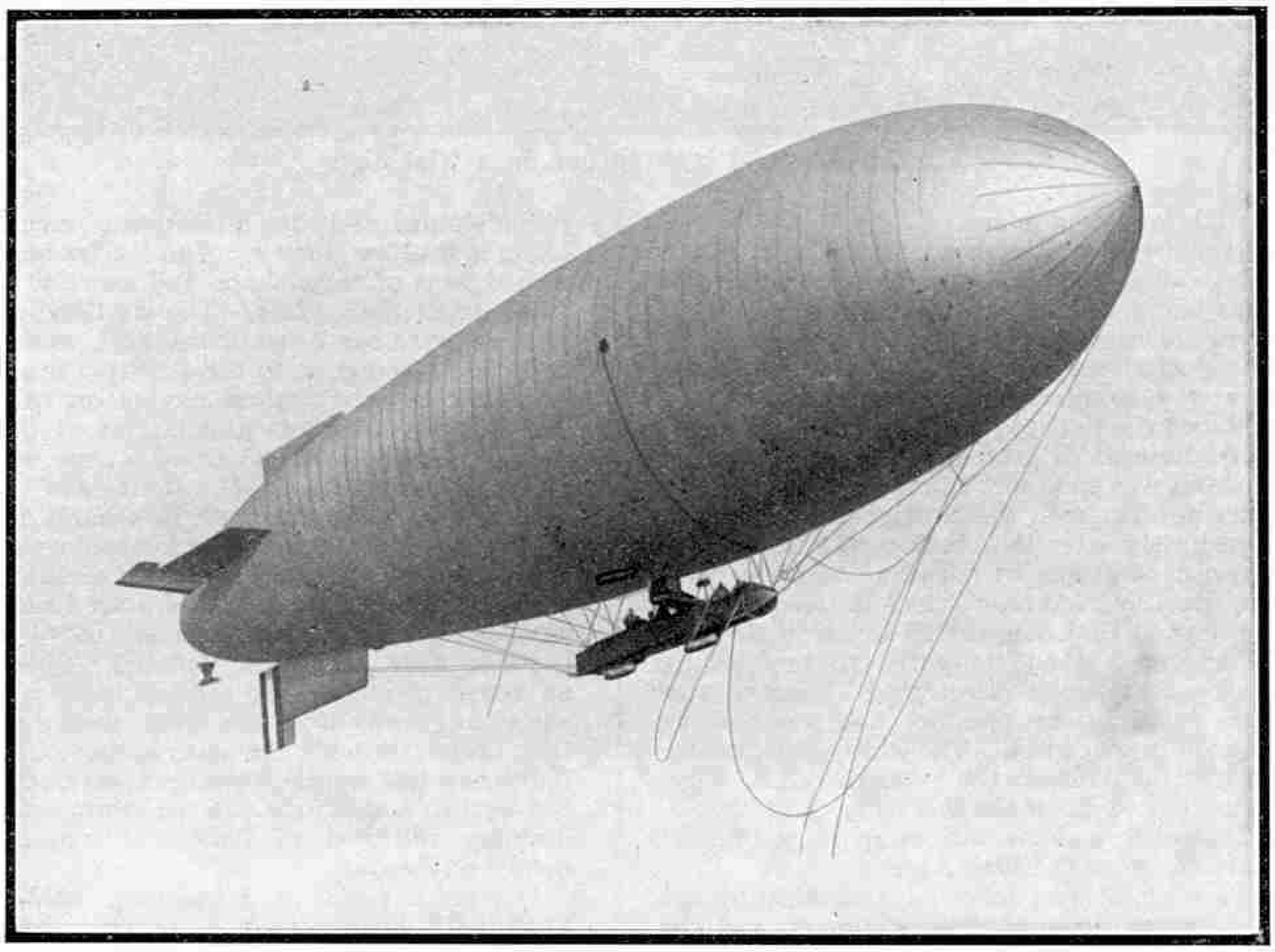
The Giant Airship Shed at Howden, Yorkshire

weather and without any particular incidents. It was performed in much better time than the outer journey and Pulham airship station was reached at 6.20 p.m. on Sunday, 13th July, exactly 3 days, 3 hours, 3 minutes after the ascent from American territory.

A curious feature about this crossing of the Atlantic by the R.34 in 75 hours is that 75 years previously the famous writer Edgar Allan Poe published in an American newspaper a story in which an English airship was described as accomplishing a flight across the Atlantic in 75 hours!

Subsequently R.34 was flown from Pulham to East Fortune and her career came to a tragic end in 1921. The airship was being held down after a flight in foggy weather and in some manner the retaining party allowed her to swing with the result that she crashed into the cliffs. The forward and after cars were smashed but in spite of this damage she was able to fly to Howden. During the following night a strong wind arose and R.34 received such a severe buffeting that she became a total wreck.

A terrible fate awaited R.38 which was only partly completed at the time of the Armistice. An offer from the United States Government to purchase this airship when completed was accepted and the work was duly carried to a finish. It was intended to fly the airship across the Atlantic, and America sent a crew to England to take charge of her. A trial trip was made on 24th August, 1921, with a number of the American crew and many eminent British aeronautical experts included among the 49 persons on board.



The U.S.A. Army's "Blimp" T.C.5, about to land at East Boston, Mass., after a trial flight from Lakehurst, N.J.

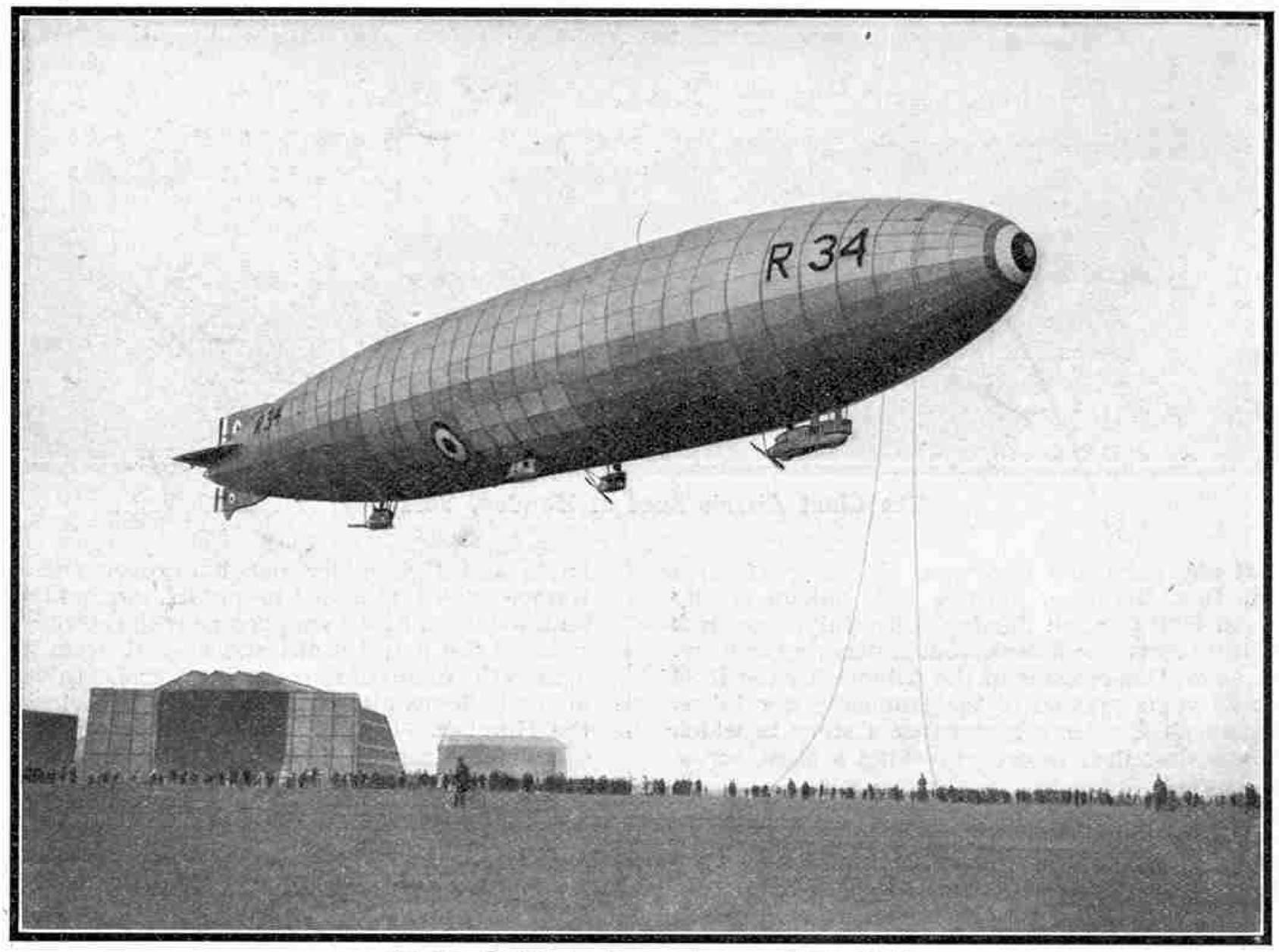
Successful high-speed tests were made and a rudder test was then undertaken. As the airship floated above the River Humber, near Hull, at an altitude of 1,200 ft., the speed was reduced to 45 knots and the rudder put hard over and then reversed. The framework of the airship proved unequal to the severe strain imposed upon it and snapped near the stern. The break fractured some of the petrol tanks and a spark from a broken electric lead ignited the fumes of the escaping petrol. In a moment the hydrogen in the balloons also caught fire and the blazing airship dived into the Humber. Only five of the crew were rescued. This terrible catastrophe cast a gloom over this country and America, and a searching inquiry was held into the cause of the disaster. The information that came to light at this inquiry taught British aeronautical engineers more than they had ever learned before of the principles of airship construction.

Airship R.33 was built at Howden near Selby, Yorkshire, by Armstrong Whitworth & Co., and was 670 ft. in length, 79 ft. in diameter at the widest part and of almost 2,000,000 cub. ft. gas capacity. Accommodation was provided for a crew of 23. The five cars beneath the great hull accommodated five 250 h.p. motors and the combined power of the engines gave the airship a maximum speed of 65 m.p.h. The petrol and water ballast tanks were carried on a massive bridge girder that extended the length of a central gangway inside the hull. A ladder containing 130 rungs provided a means of passing from the bottom of the hull to a small roof platform, upon which an anti-aircraft gun could be mounted if necessary. The airship was steered to right or left by means of two rudders attached to two vertical fins at the stern, and movable elevators were attached to the two large horizontal fins also at the stern.

Several experimental flights were made with R.33, but it was deflated and stored away when airship activity in England was

suspended in 1921, and it was not re-commissioned until May, 1924. The reconditioning of the airship was then put in hand at the Royal Aircraft factory at Bedford and was completed by 2nd April, 1925. The airship was then flown to Pulham, where she gained publicity a fortnight later by breaking away from the mooring tower during a gale. The gale sprang up on the evening of 15th April, 1925, and continued throughout the night and most of the following day. A careful inspection of the airship and its anchorage was made on the night of 15th April and everything appeared in order, but during the following morning a portion of the fitting on the mast-head fractured and freed the airship.

About two-thirds of the crew were aboard at the time, and as the R.33 was swung away from the mast by the wind a rush was made to start the engines, and water ballast was quickly released from a forward tank in order to lift the airship. Even so, she narrowly escaped trailing over some buildings in the neighbourhood. Although the engines were quickly got to work the 50 m.p.h. wind rapidly drove the airship eastward, in which direction the commanding officer wisely kept her directed in order to avoid further damage.



Airship R.34 starting out on a trial flight

The severe wrench given by the tower-head fitting as it broke away had crushed in the nose of the airship and ripped open and deflated the foremost gas bag. The officer in command ascended the ladder to the roof platform and struggled along against the wind to the nose and inspected the damage. Subsequently four of the crew made their way along the narrow gangway in the bottom of the hull and laced the deflated gas bag to the frame so that it formed a sort of bulkhead to protect the second gas bag.

The east coast of England was soon left behind and the airship still being hustled by the wind crossed the North Sea to the coast of Holland. From immediately after the break-a-way at Pulham until her subsequent return she was in constant wireless communication with the Air Ministry. At four o'clock in the afternoon of the 16th April, she reported that she was 25 miles W.N.W. of Texel, and was stationary in a wind computed to be blowing about 32 miles per hour. A message transmitted 2½ hours later stated that she was then passing over Ymuiden and was making eight knots sternway in a 40 m.p.h. wind. The wind subsequently decreased steadily and at 8.30 p.m. on the same day R.33 wirelessed that she had commenced to make her way back home. Progress was very slow, however, and she did not arrive at Pulham until 3.20 p.m. on the afternoon of the 17th April.

The hazardous voyage of R.33 was followed anxiously by the public of all countries interested in airship development, and the slight damage incurred was considered a testimony to the excellence of the materials and workmanship embodied in her.

The airship R.36 like R.38 was not completed when the Great War came to an end and her internal arrangements were then re-designed to enable her to be finished as a commercial airship. This change of plan gave the R.36 the distinction of being the first British airship to be equipped with a saloon. This was situated below the keel and contained a kitchen, tables and chairs, etc., accommodation being provided for 30 passengers. The airship was built by William Beardmore and Company Limited, and was 672 ft. in length, 78 ft. 9 in. in diameter at the widest part and was of 2,101,000 gas capacity. She had a maximum speed of 65 m.p.h. No flights of any outstanding merit are recorded of this airship.

The completion of England's latest rigid airships R.100 and R.101 is awaited with great interest. Details of these great dirigibles have been given in the "Air News" columns of the "*M.M.*" from time to time. The R.100 is being constructed at Howden and R.101 at Cardington. Work upon R.100 is now almost completed. This airship is 709 ft. in length, 130 ft. in diameter at the widest part and has a total lifting force of 158 tons. The combined power of the six 700 h.p. Rolls-Royce engines will enable the airship to attain a maximum speed of 82 m.p.h. The control cabins, and accommodation for both crew and passengers are inside the main hull framing.

Our survey of the great airships of the past 20 years would be incomplete without some mention of America's part in developing huge rigid airships. America's first rigid airship was built in 1923 by the Construction Corps of the U.S. Navy. The parts of the airship were made at the Naval Aircraft Factory at Philadelphia, and the airship was erected in a huge hangar at Lakehurst, New Jersey. The "*Shenandoah*," as the airship was named, was of cigar shape and was 680 ft. in length and 79 ft. in diameter at the middle. The six 6-cylinder engines, each housed in a separate car beneath the hull, were each capable of 300 h.p. at 3,000 ft. and gave to the airship a maximum speed of 65 m.p.h. The pilot and the various navigating instruments were accommodated in the foremost and largest of the cars, which was 20 ft. in length. The airship carried a crew of 22.

At the conclusion of a four-days' test the "*Shenandoah*" was moored to a tower at Lakehurst Station on 16th January, 1924. A gale of 75 m.p.h. velocity developed during the afternoon and in the evening tore the great airship from her mooring. The nose was left fastened to the mast head and a long strip of the envelope was torn from the starboard bow, while two forward gasbags were torn and deflated. Sufficient of the crew were on board to enable the airship to be efficiently handled, and as she swung away from the tower they dropped two of the forward fuel tanks through the canvas bottom in order to restore the buoyancy lost by the damaged gas-bags. By careful navigation the airship safely rode out the storm and very early the following morning returned to Lakehurst where she was safely housed before daybreak.

During a flight in September, 1925, the "*Shenandoah*" unexpectedly encountered a terrific storm and was completely wrecked. The storm was of the kind known as a "line" storm, which the designers of the airship had declared would probably prove fatal to her if ever she encountered one. A line storm is a vast wall of upward rushing air, and the one that the "*Shenandoah*" ran into shot her upward from her altitude of 3,000 ft. to a height of 7,000 ft. as though she were a mere toy. A severe vertical bending stress was at once set up in the forward part of the framework of the airship. The commander ordered the valves to be opened and, with gas escaping freely and engines running, the airship was canted nose downward. Thrust out of the stream of upward rushing air the "*Shenandoah*" descended

so rapidly that the gas tanks had to be hurriedly dropped and large quantities of water ballast discharged in order to stay her plunge. By the time she had regained the 3,000 ft. level she was restored to an even keel and all seemed well again.

The terrific blow dealt by the line storm had taken effect, however, for hardly had the airship recovered her equilibrium when she broke in two about 250 ft. from the bow. As the two portions of the great airship fell, the forward one snapped into two pieces, shearing off the control car, which met the earth with a terrific impact, killing every occupant. The long after section of the airship fell stern first, the tail crushing up on coming into contact with the earth and forming a cushion that softened the fall of the broken framework and cars so that the crew housed in cars attached to this section were saved. The loss of the vessel and of several of its personnel created dismay throughout America and for a time confidence in rigid airships wavered.

The U.S. airship "*Los Angeles*" is of almost the same dimensions as the "*Shenandoah.*" She was built for the U.S. Navy by the Zeppelin Company in Germany, under the designation "*ZR.3*," and was delivered by air, achieving the long flight of 5,060 miles from Friedrichshafen to Lakehurst in 81 hours. She has five 12-cylinder Maybach engines, specially designed for airship service, and each capable of 400 b.p.h. at 1,400 revs. per min., and has a maximum speed of 78 m.p.h.

When not in flight airships are either anchored to special structures known as airship mooring towers or are housed in huge sheds. Mooring towers were invented after the loss of the British airship R.34, which was wrecked during a gale owing to being inadequately anchored to the ground, as already related.

An airship mooring tower has recently been completed at Cardington, Bedfordshire, in preparation for the handling of the new British airships R.100 and R.101. This tower is an octagonal structure having an overall height of 200 ft. and tapers from a width of 70 ft. at the base to about 27 ft. across the top. A spiral staircase 3 ft. in width and an electrically operated passenger lift are accommodated up the centre of the tower. The power-house and winding-shed, for operating the lift and the cable for hauling in the airship, are situated at the base.

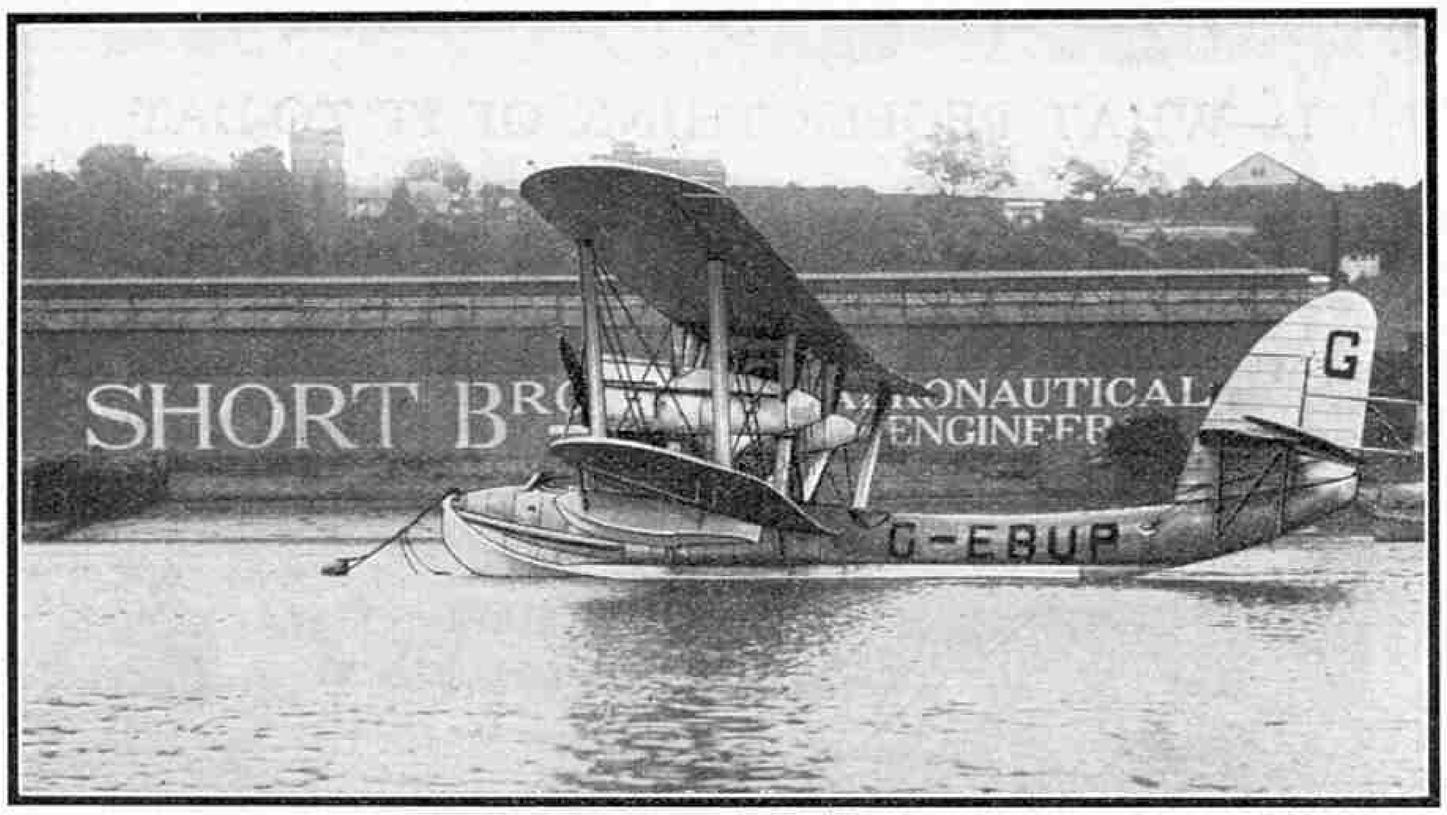
The tower is surmounted by a turret in which is accommodated a wonderful machine, weighing some 10 tons, the purpose of which is to respond to the pull of a moored ship upon the cable that holds it to the mast. The machine is free to move in all directions and thus adjust itself instantly to any changes in the pull of the ship, due to variations in the direction of the wind. The ship is held to the mast by its "nose," on which there is a fitting that is hauled by means of the cable into a cup-shaped recess at the extreme top of the mast. Around the mast at a distance of about 100 yards are ring-bolts set in concrete, to which is anchored the stern cable of the ship.

The passengers enter the ship by means of a gangway in the bow. This gangway is lowered to the top platform and fits into a circular rail running round the mast, thus enabling it to move in any direction in accordance with the movements of the ship, caused by changes in the direction of the wind.

The shed built by Count Zeppelin to house his first rigid airship was a timber structure erected upon pontoons on Lake Constance. This shed had the great advantage of being movable so that it could be swung round to face any particular direction according to the prevailing wind.

The airship sheds in England are built on land and, of course, are not movable in this manner. The most notable of them is the gigantic shed at Cardington. This consists of a massive steel framework of latticed girders built upon a concrete foundation. The walls are formed of corrugated iron sheeting while special protective material has been used for the roof. The shed is 812 ft. in length and has a maximum height of 180 ft. Its floor area is 4¾ acres and it will accommodate two airships of the R.33 type or one of the size of R.100.

BACK FROM HER 23,000 MILE TRIP



Courtesy] [*Messrs. Short Bros. Ltd.*

An interesting photograph showing the "Singapore" back at her original moorings after her aerial survey flight around Africa.

This famous Flying Boat is fitted with two Rolls-Royce "Condor" engines and weighs, fully laden, 20,050 lbs. The dimensions of the "Singapore" are roughly the same as those of the "Calcutta" Flying Boat, described in the "M.M." last month.

Outdoor Recreation Books

An interesting new series of small books on sports and games has been commenced by Frederick Warne & Co. Ltd., under the general heading of "*Warne's Recreation Books.*" Eight volumes are already available, dealing respectively with motor-cycling, golf, bowls, cricket, rowing and sculling, lawn tennis, camping and swimming. The volume on camping (No. 2 of the series) will be of special interest to Meccano Clubs that are contemplating holding a camp during the summer.

Each book is written by an expert and contains sound practical advice on the essential features of each sport. The style is clear and simple and the book cannot fail to be of interest, not only to beginners but also to those of considerable experience. The written descriptions of the various points are supplemented by simple but expressive sketches, which leave no doubt in the mind of the reader as to the author's meaning. The general get-up of the books is attractive and they are published at the remarkably low price of 6d. in paper covers or 9d. in cloth.

The Making of a Cricket Bat—

(*Continued from page* 609)

from pieces of cane, the number employed varying from nine to sixteen according to the thickness of the cane that is being used. The most suitable cane for the purpose is grown in Sarawak in the East Indies. If, for instance, nine canes are to be used in the making of a handle, these are all planed singly and are then glued into three slips of three canes each. The three slips are then planed and rubber is inserted between them, the inner slip being cut down if treble insertion is required. The slips are then glued together and after the glue has set the handle is turned and pointed to correspond with the V cuts that have been made in the blade.

The handle is now fixed into the blade at the correct angle and the shaping of the bat is commenced. This shaping is entirely carried out by hand and is of great importance, as upon its accuracy depends the correct balance of the bat. The usual weight of a full-sized bat is from 2 lb. 4 oz. to 2 lb. 7 oz., but a badly-balanced bat of the lighter weight would feel heavier to handle than the heavier bat correctly balanced.

Finally the handles are wound with twine and the bats are rubber grip fitted, branded and finished off ready for sale.

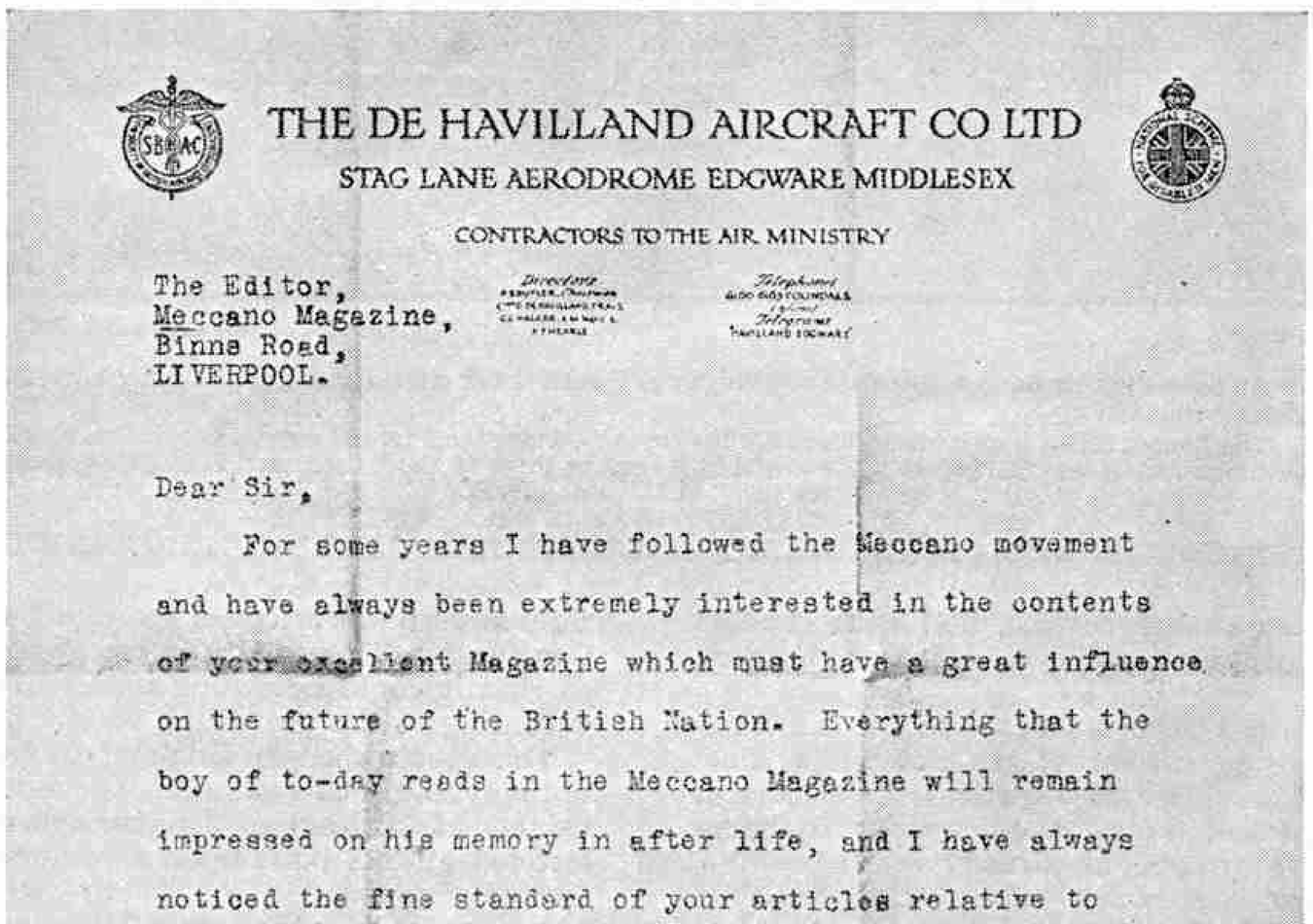
The upper illustration on page 609 shows Herbert Sutcliffe, the great Yorkshire and England batsman, instructing a schoolboy in the art of holding the bat correctly. The lower photograph, showing Sutcliffe completing a stroke, is of unusual interest. One wonders how many readers could state exactly the nature of the stroke and the direction in which the ball has gone!

I.—WHAT PEOPLE THINK OF IT TO-DAY

WE believe that the "*Meccano Magazine*" is unique among publications of its type, in the rapidity of its growth and development, and in the intense interest shown by its readers in "things that matter." For a long time we have been receiving large numbers of requests for some information about the Magazine—how it is prepared, printed and distributed, and where all the illustrations come from. Up to the present space has prevented us from complying with these requests, but an opportunity now occurs and we propose to take our readers into our confidence and show them something of what goes on "behind the scenes."

First of all let us say something about the development of the Magazine and the position it occupies to-day. The first issue of the Magazine appeared in September 1916, as the result of continued demands from Meccano boys for a publication of their own. This first issue consisted of only four pages and was devoted entirely to Meccano, its sole object being to show Meccano boys how to get more fun out of their hobby and in particular to encourage them to build new models of their own invention.

For some time the Magazine appeared once every two months and did not alter greatly in its scope. Later, readers began to ask for articles on various engineering subjects that interested them. The first two or three articles that appeared in response to these requests met with such an enthusiastic reception that they were incorporated as a regular feature, and their number and length steadily increased. From that time the size and the scope of the Magazine have developed year by year, until to-day it is recognised all over the world as the greatest of all non-fiction papers for boys.



THE DE HAVILLAND AIRCRAFT CO LTD

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CONTRACTORS TO THE AIR MINISTRY

The Editor,
Meccano Magazine,
Binns Road,
LIVERPOOL.

Dear Sir,

For some years I have followed the Meccano movement and have always been extremely interested in the contents of your excellent Magazine which must have a great influence on the future of the British Nation. Everything that the boy of to-day reads in the Meccano Magazine will remain impressed on his memory in after life, and I have always noticed the fine standard of your articles relative to flying.

I do sincerely hope that all Meccano readers will take a live interest in aviation, because I think that the popularity of flying is more important to the future of the British Empire than any other modern development. Remember it is quite easy to fly, and it is now being made very simple for any enthusiast to learn how to fly.

Wishing you every success.

Yours sincerely,

Alan Cobham

The secret of the success of the "*Meccano Magazine*" lies in the fact that it deals with subjects that are of interest to all intelligent boys, and deals with these subjects seriously. Our whole object is to provide articles that are accurate from an engineering and scientific point of view, and at the same time are written in an interesting style, free from all unnecessary complications and technicalities. The result is that the publication day of the "*M.M.*" is eagerly anticipated month by month by boys all over the world.

Over 60,000 copies of the Magazine are printed every month and some 20 tons of paper are required for the job. If all the copies that are printed for one month's issue were stacked one upon another they would make a pile 675 ft. in height; that is rather more than two-thirds the height of the Eiffel Tower! If a month's magazines were placed end to end they would stretch for over 10 miles. The area of the paper used each month is over 76 acres in extent—in other words there would be sufficient to cover nearly 1,600 lawn tennis courts. If the printed pages in one month's issue were placed end to end they would form a continuous band over 916 miles in length—more than sufficient to lay a line the width of the "*M.M.*" page from Lands End to John o'Groats. If all the lines of reading matter in one complete issue could be placed side by side they would extend for roughly 30,000 miles—in other words Sir Alan Cobham could have laid a line of print all the way to Australia and back.

Although the bulk of the magazine circulates in the United Kingdom, many thousands of copies go overseas every month, in particular to Australia, New Zealand and South Africa. The magazine has, in fact, readers in every civilised country in the world, even in such far away places as Siberia, Labrador, Fiji and Tierra del Fuego.

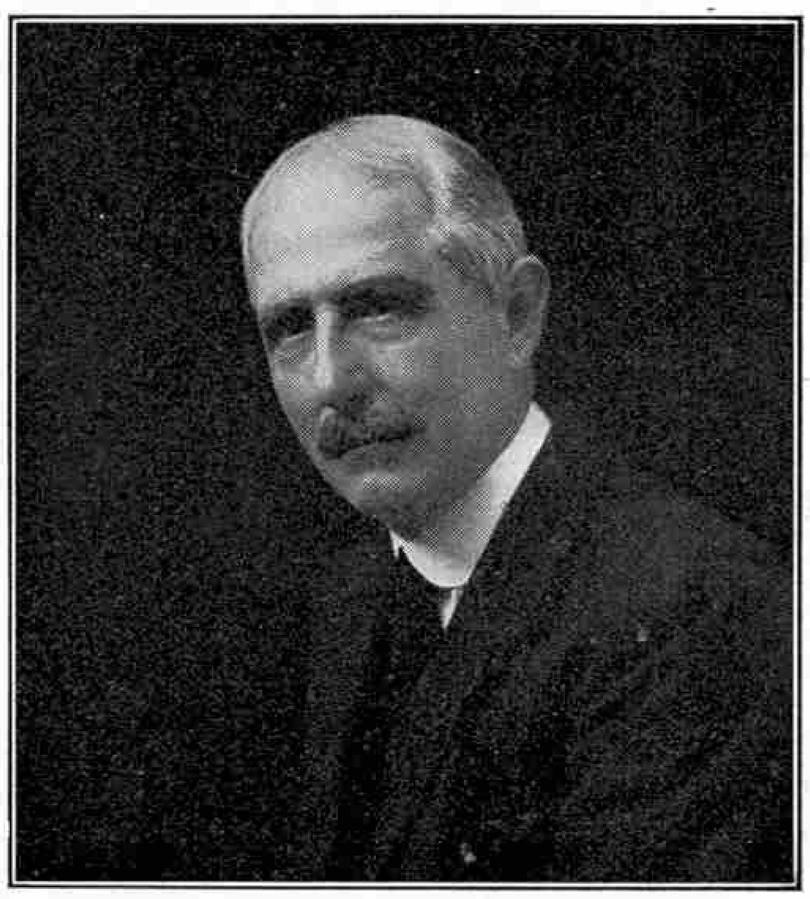
Naturally the early issues of the "*M.M.*"—four pages unattractive in appearance, and devoted entirely to Meccano model-building—did not often attract "grown ups." Now, all that is changed and in many thousands of homes the "*M.M.*" is welcomed and appreciated as much—sometimes even more!—by adults as by the most enthusiastic Meccano boy. Indeed, we receive many letters from boys complaining that father gets hold of the Magazine first, and keeps it until he has read it from cover to cover! Others complain that on the first of the month they notice they are always sent to bed early, so that father can have the "*M.M.*"! In such cases we

point out that as Dad usually pays the subscription he is entitled to "first whack" at the Magazine, and that in any case there is always a remedy for this state of affairs—to order two copies!

During the past few years the soundness of the information contained in the "*M.M.*" has attracted increasingly the attention of engineers, inventors, scientists and schoolmasters. Many have written us most encouraging letters, expressing their appreciation of the ideals and objects of the Magazine and congratulating us upon the success already achieved.

The commendation of engineers is especially encouraging to us because the "*M.M.*" is essentially an engineering paper for boys. We greatly appreciate, for instance, the following remark in the course of a letter from Dorman Long & Co. Ltd., the famous engineers who are now engaged in the colossal task of constructing the Sydney Harbour Bridge:—"We know your Magazine well and appreciate its educational value to those who, as you rightly remark, will become the engineers of the next generation."

Then, again, Dr. H. S. Hele-Shaw, F.R.S., formerly Professor of Engineering at Bristol University and Liverpool University, and the inventor of many successful mechanisms among which may be mentioned the Hele-Shaw clutch, wrote to us a short time back:—"Allow me to congratulate you on the whole Magazine which I, although an old man, read with interest. As Past President of the Institution of Mechanical Engineers I venture to say that your firm and you yourself are doing a great work for the youth of this country. When I remember that, on my first acquaintance with Mr. Hornby, he made his models in his own parlour, and now see the picture of his Meccano works, it makes me proud to think that the organisation is British."



Dr. H. S. Hele-Shaw, F.R.S.

We know that the heads of many engineering firms attach considerable importance to the value of Meccano model-building to the youth who intends to become an engineer. A particularly practical illustration of this belief was given at a recent exhibition at Bexhill-on-Sea, where the principal of a certain engineering firm, after examining the display of Meccano models, announced that he would be willing to reduce by six months the period of apprenticeship required at his works to any boy who could build successfully the Meccano Chassis model.

In regard to aviation, our aim is to do something towards the development of air-mindedness in the next generation, and here again our efforts have met with encouragement from famous pilots and from great commercial flying organisations, such as Imperial Airways. We regard with particular pride a letter from Sir Alan Cobham, the world-famous British pilot, in which he says:—"For some years I have followed the Meccano movement and have always been extremely interested in the contents of your excellent Magazine, which must have a great influence on the future of the British nation. Everything that the boy of to-day reads in the "*Meccano Magazine*" will remain impressed on his memory in after life, and I have always noticed the fine standard of your articles relative to flying."

We received an amusing letter from the Editor of "*The Aeroplane*" in reply to a letter of ours in which we said that, as far as aviation was concerned, we sometimes felt ourselves "a Voice crying in the Wilderness." The Editor replied:—"It strikes me that the '*Meccano Magazine*' can scarcely be called "a Voice crying in the Wilderness.' There does not seem to be much wilderness when you have a following as large as *you* have—unless of course you regard yourself as being like Moses with all the Children of Israel around him!"

Little by little during the past few years Meccano has made its way into schools all over the country. It has proved itself remarkably useful in the construction of models for teaching such a subject as mechanics, and in the fitting up of apparatus for chemical and other experiments. More recently Meccano has been followed by the "*Meccano Magazine*," and scarcely a week passes without our receiving appreciative letters from schoolmasters. The following letter, for example, comes from the master of a boys' school in London: "It may also interest you to know that I often make use of Meccano in the ordinary science lessons in which I specialise. I am sure that far too little time is given in present-day elementary science teaching to mechanical principles and in the teaching of these I find Meccano an unrivalled assistant. The last hour on Friday afternoons I often use in allowing the boys to bring their sets and make models and display their working to the less fortunate boys."

There is ample and welcome evidence that the "*M.M.*" appeals also to the shrewd business man, although he may have no direct connection with engineering or science. As an instance of this we may mention Sir William S. Crawford, K.B.E., Chairman and Governing Director of the well-known firm of advertising agents, W. S. Crawford Limited. The opinion of a man of such wide experience as Sir William, who stands in the forefront of his profession and is known all over the world, is of considerable value and for that reason we are glad to be able to quote the following passages from a recent letter from him. "I have read through the "*Meccano Magazine*" with the greatest interest. To my mind it fills a much-needed gap in boys' literature. You give them something better than hair-raising stories of adventure. You give them instructive information in a most attractive form, each subject being treated in the most interesting manner possible. It is a magazine to make boys think, and think on constructive lines. Congratulations on a fine effort well carried out."

Sir William Crawford, K.B.E.

As we have already stated, we endeavour to maintain the most scrupulous accuracy in our statements and descriptions, and every now and again comes along encouraging evidence that this labour is appreciated by experts. For example, some time ago we prepared an article on an electric arc produced by a pressure of one million volts in the experimental laboratories of Ferranti Limited, Hollinwood, Lancashire. This article involved a description of a somewhat complicated matter—"root-mean square" or, as usually expressed, "R.M.S." current values, and Ferranti Limited subsequently wrote:—"We must congratulate you on the lucid description for R.M.S. values. It is one of the simplest we have seen."

On another occasion, after the appearance of the article on "Silk" in our issue for October of last year, the Director of a large firm in the Midlands wrote to us:—"I must congratulate you especially on your October number containing the article on 'Silk.' This was shown to our Director in the Silk Department who is supposed to be the greatest authority on raw silk and manufacturing from same in Great Britain; so much so that when the new tax was being discussed the "*Daily Mail*" wired down for his opinion and his remarks were printed side by side with their article. He spoke of your article as being very fine indeed. Personally, I think for a boy, or a man who can think as a boy, the Magazine is the most interesting and attractive that could be produced."

In our next and subsequent issues we intend to describe in detail how the "*M.M.*" is produced. Starting with the troubles and trials of the Editor and his assistants, we shall show how the copy is prepared; how it is set up in type; how the blocks for the illustrations are made; how the paper is made; and finally how the complete Magazine is printed, folded and stitched, and distributed to its waiting readers all over the world, whose interest in its pages will no doubt be greatly stimulated by their knowledge of the organisation behind it.

NEW SERIES:

Famous Aero Engines

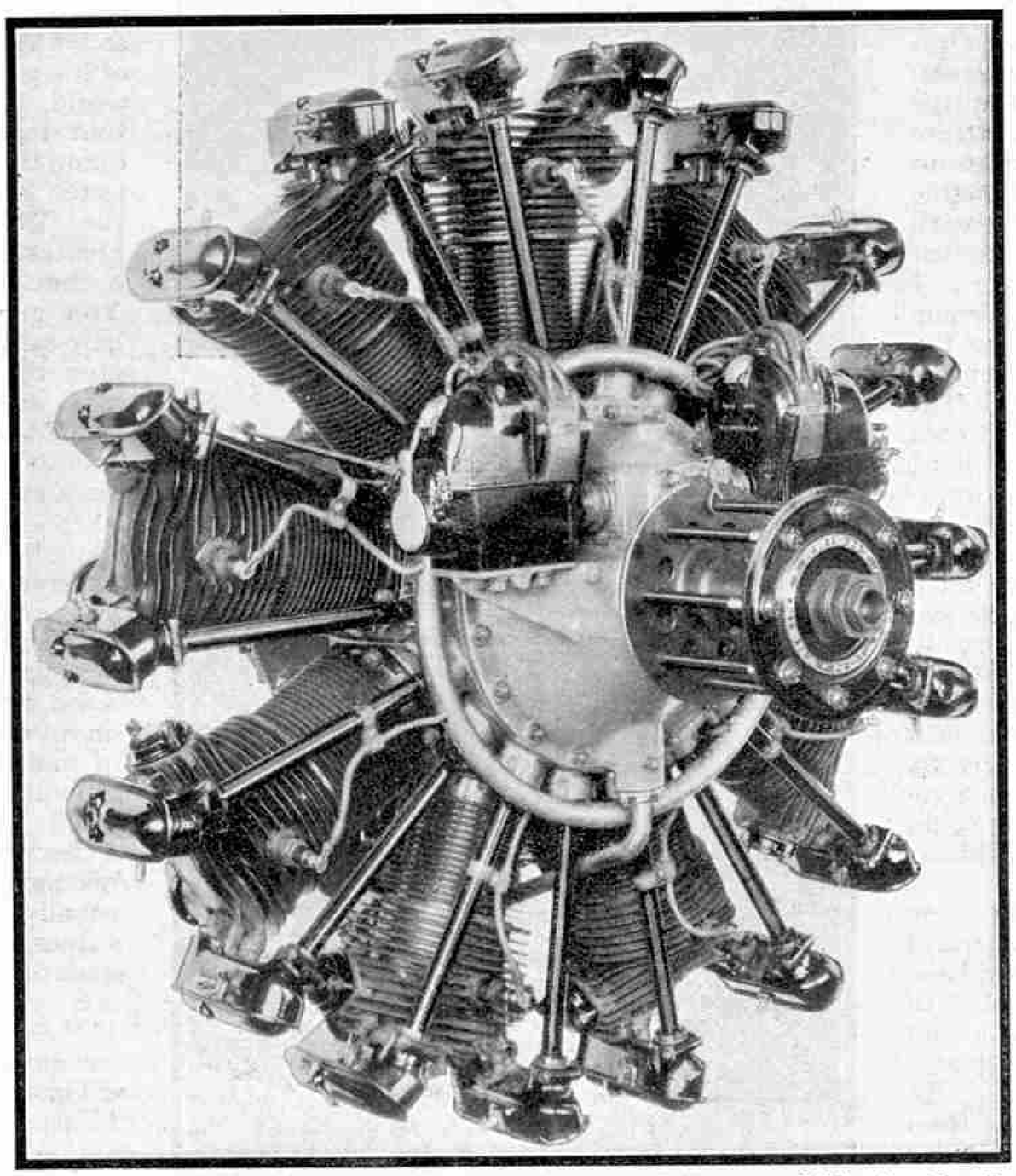
I.—The Wright "Whirlwind"

THE efficiency of present-day aeroplane engines is remarkably high, and therefore any engine that forces itself into a prominent position must possess features of quite outstanding quality. This is notably the case with the Wright "Whirlwind" J5 engine, which has reached its present eminence as the result of its complete success during such remarkable flights as that of Commander Byrd across the North Pole in May 1926, and of Colonel Lindbergh across the Atlantic a year later. The J5 model is the result of seven years' intensive development of the original engine, without alteration in bore or stroke and without change in any basic feature of the design.

In 1916 Mr. Charles L. Lawrence, President of the Wright Aeronautical Corporation, started to develop air-cooled engines of small power. His experiments led him to the belief that larger powers could be constructed, but for a long time no successful American air-cooled engine producing more than 100 h.p. was built. At the close of the Great War the entire American aircraft industry was concentrated upon the production of water-cooled engines. This concentration resulted from the fact that the early American water-cooled aircraft engines had been more successful than machines of the air-cooled type. There was a general feeling that the expense of developing the air-cooled principle would be so great as to be unjustified by probable results.

Early in 1920 Mr. Lawrence produced a nine-cylinder air-cooled radial engine of 140 h.p. and the success of this engine, and of a similar one of 200 h.p., proved conclusively the practicability of the air-cooled principle. The second of these engines was the forerunner of the now famous series of Wright "Whirlwind" engines. Seven successive models have been brought out and each has been produced in quantity for the United States Navy before being released for commercial sale. In this manner commercial aviation in the United States has had the benefit of thoroughly tested engines of a design already approved and tried by the United States Navy.

Many advantages are claimed for air cooling. The air-cooled system transfers the heat of combustion directly from the cylinder to the atmosphere; the water-cooling system transfers this heat from the cylinder to the cooling water and then to the atmosphere by means of the radiator. Air-cooling is the more direct method and results in a lighter engine, and also a smaller one on account of the elimination of water, radiator, piping and shutters. The reliability of the air-cooled type has been proved beyond all doubt during the past few years.



Courtesy ["*The Aeroplane*"

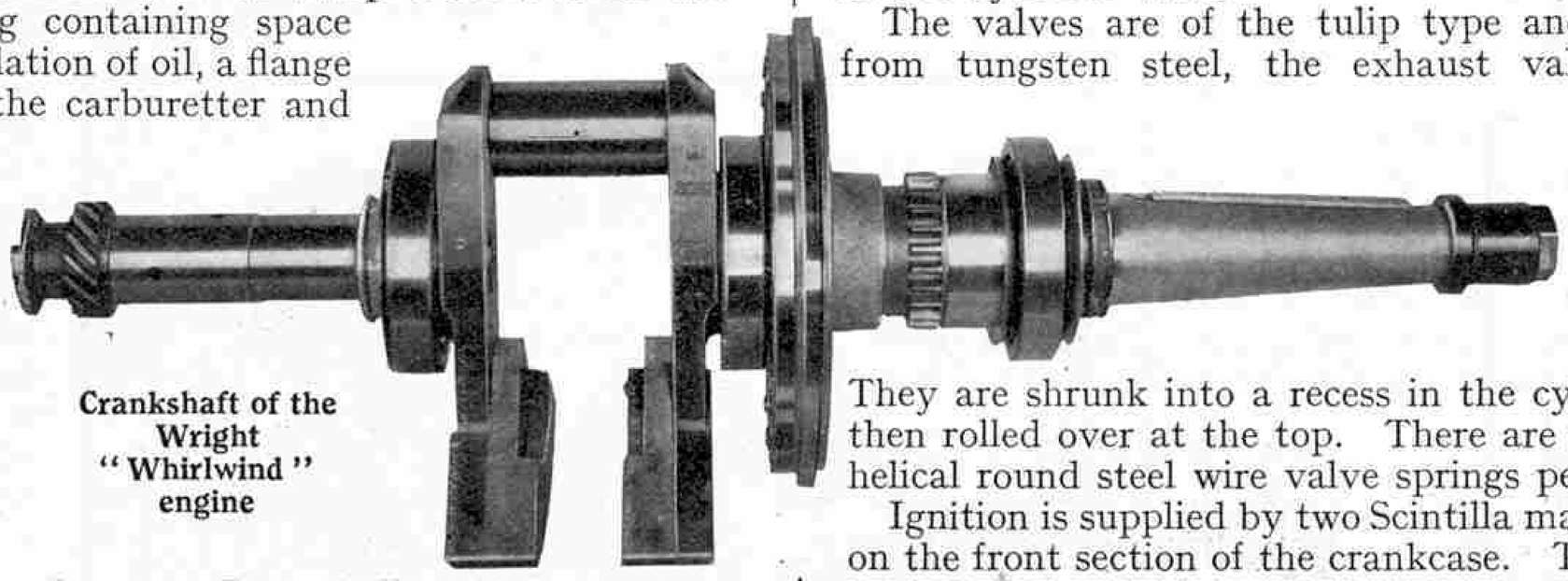
Front view of the engine that carried Lindbergh from New York to Paris

The Wright "Whirlwind" engine of the J5 series is of the nine-cylinder air-cooled radial type operating on the conventional four-stroke cycle. The rated power is 200 h.p. at 1,800 r.p.m. while the average power at this speed is 223 h.p.

The cylinder consists of a head with integral fins cast in aluminium alloy, screwed and shrunk on to a forged steel barrel with integral fins and hold-down flange. The combustion chamber is hemispherical with valves inclined to the axis of the cylinder at angles of 35°. There are two spark plugs per cylinder, located in bronze bushings, diametrically opposite in the sides of the combustion chamber, at an angle of 10° to the crankshaft axis. The cylinder head contains two ports, the axes of which are at right angles to each other. The port facing aft is for the attachment of the intake pipe and the port at the side of the cylinders is for the attachment of exhaust manifolds. The cylinder is attached to the crankcase by eight studs passing through the flange.

The crankcase is built up of five aluminium alloy castings secured together by a generous number of studs and nuts. The front section includes the thrust bearing housing, magneto brackets, and the magneto and cam driving gears. The intermediate section contains the cam and valve tappet mechanism and housing for the front crankshaft bearing. The main

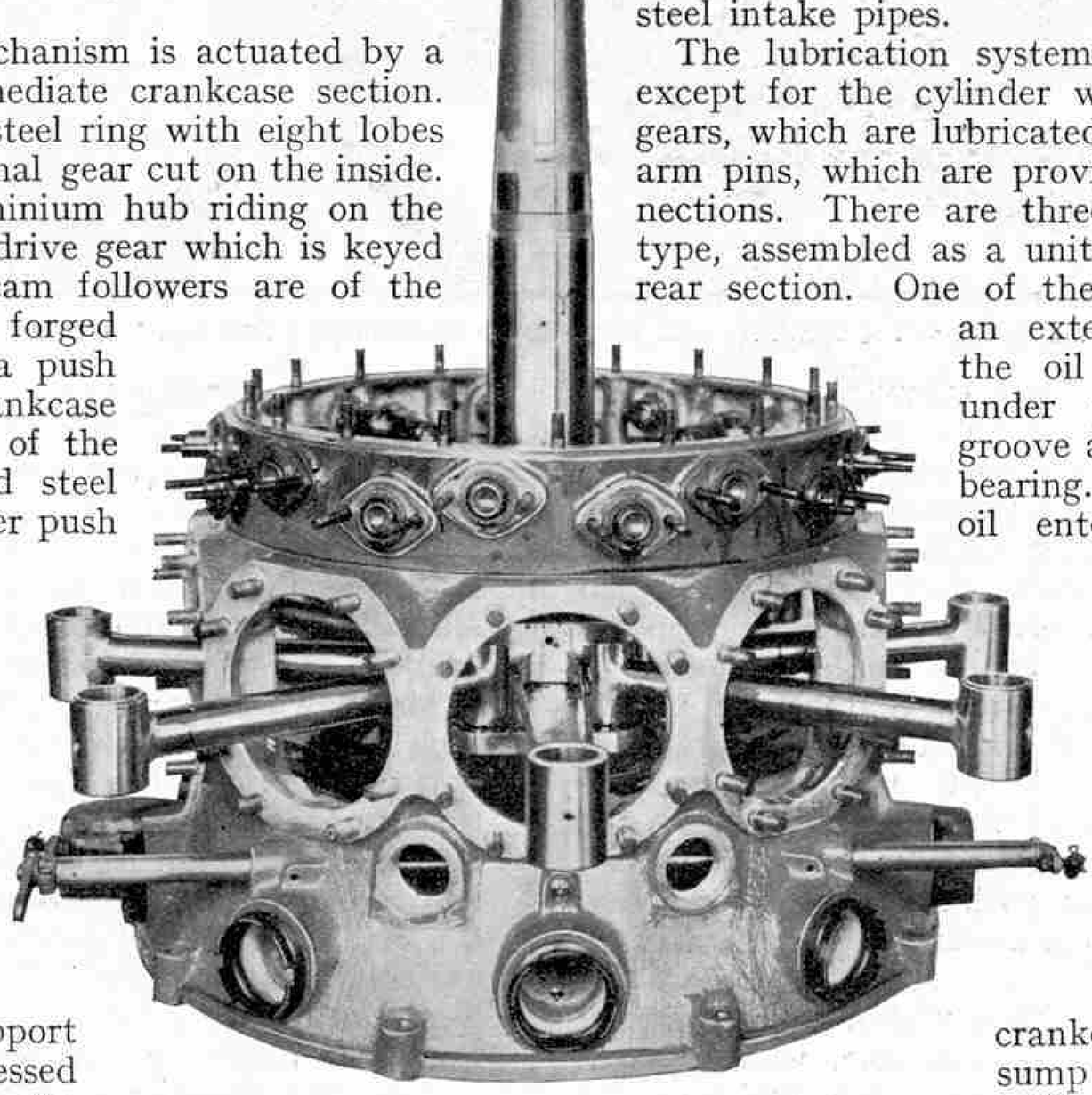
section is provided with pads for the attachment of cylinders and contains the flange for mounting in the airplane, and the housing for the rear crankshaft bearing and intake passages. The rear section contains drives for the oil pumps, fuel pump, gun synchronizers and tachometers. It also provides a mounting for the engine starter and a housing for the main oil strainer. The intake manifold and oil sump section is an aluminium casting containing space for the accumulation of oil, a flange for mounting the carburetter and the intake passages.



Crankshaft of the Wright "Whirlwind" engine

The crankshaft is of the single throw counterbalanced type, machined from a chrome-nickel steel forging and machined all over. It is hollow throughout its length and is used to distribute oil to all parts of the engine. Counterweights are bolted to extensions of the crankcheeks. The shaft runs in four bearings; a ball thrust bearing, two main ball bearings and a plain bearing in the rear crankcase section where the oil is admitted. To the crankshaft are attached gears which drive the cam and accessories, the ball bearings, starting dog, oil slingers and the propeller hub key.

The valve operating mechanism is actuated by a cam located in the intermediate crankcase section. It consists of a hardened steel ring with eight lobes on the outside and an internal gear cut on the inside. This is riveted to an aluminium hub riding on the sleeve portion of the cam drive gear which is keyed to the crankshaft. The cam followers are of the roller type, operating in forged steel bushings which are a push fit in the intermediate crankcase section. The upper ends of the followers contain hardened steel sockets into which the lower push rod balls fit. The push rods are of nickel steel tubing with hardened steel balls pressed into either end. The upper balls fit into hardened steel cups which are a loose fit inside the clearance adjusting screws at the outer ends of the rocker arms. The valve gear is enclosed by rocker arm housings which form the support for the rocker arm pins. Pressed steel covers are used on the rocker arm housings and the push rods are enclosed by tubular steel housings.



Crankcase main section assembled ready for attaching end sections and fitting cylinders

The connecting rods consist of one master and eight link rods machined from chrome-nickel steel forgings. The master rod is provided with a steel backed babbit lined bearing at the crankshaft end. The piston pin and knuckle pin bushings of the link rods are of bronze.

The pistons are of cast aluminium alloy with the inside of the head heavily ribbed to obtain additional strength and cooling. There are three compression rings above the pin and one oil scraper ring at the bottom of the skirt. The piston pins are of oil hardened alloy steel. They are of the full floating type with aluminium alloy plugs in the ends to prevent scoring of the cylinder walls.

The valves are of the tulip type and are machined from tungsten steel, the exhaust valves being salt cooled. The valve seats are annular rings of aluminium bronze of rectangular cross section. They are shrunk into a recess in the cylinder head and then rolled over at the top. There are three concentric helical round steel wire valve springs per valve.

Ignition is supplied by two Scintilla magnetos mounted on the front section of the crankcase. The ignition wire is of the heavily insulated high tension type largely enclosed in metal manifolds.

The carburetter is of Stromberg make and is of the three barrelled type with a mechanical economizer. It is fastened to an oil jacketed manifold sump attached to the bottom of the crankcase main section, which provides three unbroken passages to the three annular passages in the main crankcase section, each of which supplies fuel to three cylinders through steel intake pipes.

The lubrication system is of the pressure type except for the cylinder walls and accessories drive gears, which are lubricated by spray, and the rocker arm pins, which are provided with grease gun connections. There are three oil pumps, of the gear type, assembled as a unit, located in the crankcase rear section. One of these pumps sucks oil from an external tank, which carries the oil supply, and delivers it under pressure to an annular groove around the rear crankshaft bearing. From this groove the oil enters the crankshaft and from there passes through various passageways to the crank pin, knuckle pins, cam and the magneto drive bearings. Oil collecting in the crankcase is returned to the oil tank by the other two pumps which scavenge the rear crankcase section and main section sump. Oil collecting in the front crankcase section drains to the sump through an external pipe.

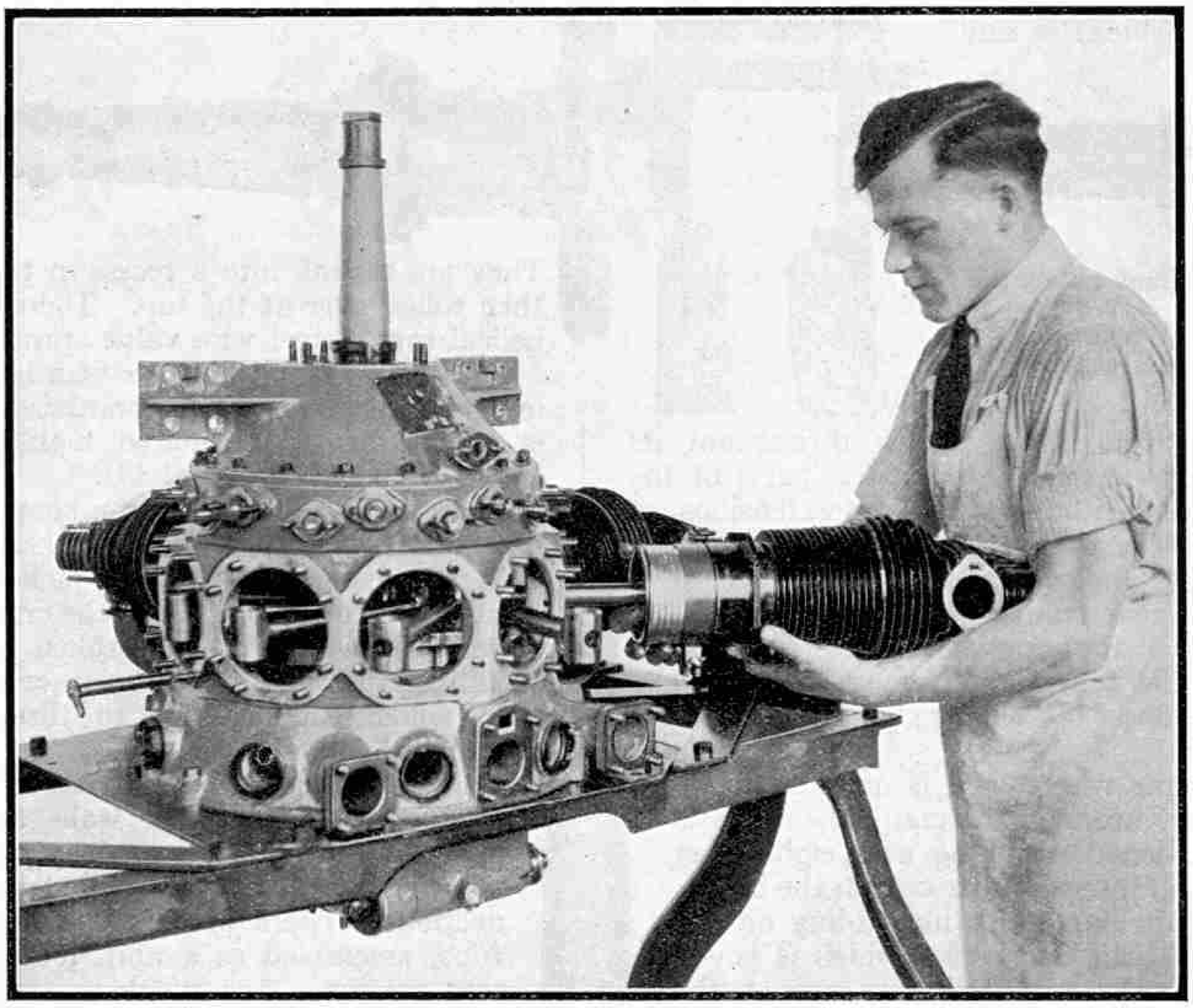
The reliability of the Wright "Whirlwind" engine has led to its adoption for many important flights, three of which are of outstanding importance.

A Fokker monoplane equipped with three "Whirlwind" engines was used by Lt. Comdr. Richard Byrd, of the United States Navy, for his great non-stop flight to the North Pole and back in 1926. King's Bay, Spitzbergen, was selected as the place from which to take

off for the Pole, and there the machine was conveyed on the steamer "*Chantier*," manned by a crew of 50, all of whom were volunteers for the voyage. When Spitzbergen was reached it was found impossible to tie the vessel up to the wharf, and the aeroplane was finally got ashore by ferrying it through the slush ice upon four lifeboats lashed together. A special runway had to be constructed for the machine to take off on its flight and a pair of skis were fitted to the undercarriage.

Everything was got ready for an early start on the morning of Sunday, 9th May, 1926, and on that day Commander Byrd and his pilot, Floyd Bennett, U.S.N., said good-bye to their companions, cinematograph pictures were taken and the engines were started up. The machine taxied along the runway, but failed to rise and ended up in a large snowdrift.

After being extricated the machine was relieved of some of its heavy load, a quantity of the petrol being drawn off. Byrd also removed everything that in his opinion could be done without, including some foodstuffs and two large vacuum flasks containing hot tea. The removal of the provisions was witnessed with dismay by Bennett and the ship's doctor, and as soon as Byrd was out of sight for a few minutes they quickly smuggled the food and flasks back again on board!



Fitting one of the cylinders over its piston in assembling a 200 h.p. "Whirlwind"

Shortly afterwards the machine made an excellent start in brilliant sunshine. From Spitzbergen to the North Pole is roughly 650 miles, and in this comparatively close proximity to the Pole the magnetic compass proved almost useless. Byrd therefore steered by the aid of sun compasses. Hour after hour the machine sped onward through the sunlight, with far below an unending field of ice, interspersed occasionally by some narrow lane of water.

Byrd had just calculated that within one hour they would be directly over the North Pole, when he discovered that the starboard oil tank was leaking. He hurriedly scribbled a note to Bennett, asking him what would happen to the engine. Bennett ceased his task of piloting the machine long enough to scribble in reply: "It will stop!" The leaking subsequently ceased, however, and the whole flight was carried out with the three engines working. When the tank was examined later it was found that a rivet had fallen out and that the leak had stopped when the level of the oil descended to the level of the rivet hole.

Several extensive plains of smooth ice were passed over, but Byrd resisted any temptation to land, knowing well that appearance were deceptive and that the ice might fail to bear the weight of the machine. When the North Pole was reached the aviators circled around for about a quarter of an hour before heading the machine back to King's Bay. The cold was intense, but the men were well clothed and experienced no discomfort, apart from a slight mishap experienced by Byrd who, while using one of the sun compasses, had to stand with his head protruding out of the trap-door in the roof of the aeroplane, with the result that his nose became frost-bitten.

The machine arrived back safely at King's Bay, the double journey having occupied 15½ hours.

An even more striking tribute to the "Whirlwind" was Colonel Lindbergh's non-stop flight from New York to Paris. Lindbergh's "Ryan" monoplane, "*The Spirit of St. Louis*," was constructed under his personal supervision and to his special requirements, one of which was that it should have a petrol storage capacity of 450 gallons. The fuel load of the machine consisted of 451 gallons of petrol and 20 gallons of oil. The take-off was made from Roosevelt Field, New York, shortly after noon on 20th May, 1927, and about midnight the machine passed over St. Johns, Newfoundland.

The Newfoundland coast was quickly left behind and soon snow and hail were encountered, of such intensity that for some time Lindbergh seriously considered turning back. Subsequently for more than 1,000 miles the machine fought its way onward through heavy rain. At one period Lindbergh descended as low as 10 ft. above the sea in the hope of getting beneath the storm. Finding conditions equally bad there, he then climbed to a height of 10,000 ft. in an endeavour to get above the rain, but again he was unsuccessful. Daylight came at last, the rain ceased, and from then to the end of the flight fair weather was experienced. The engine was run throughout the flight at about three-quarter throttle, except at the commencement of the journey and during the endeavour to mount above the storm.

Exactly 33½ hours after leaving New York "*The Spirit of St. Louis*" descended at Le Bourget, the well-known French air port, and thus ended a record non-stop flight of 3,610 miles. Lindbergh subsequently declared that the "Whirlwind" never faltered once

during the long trip.

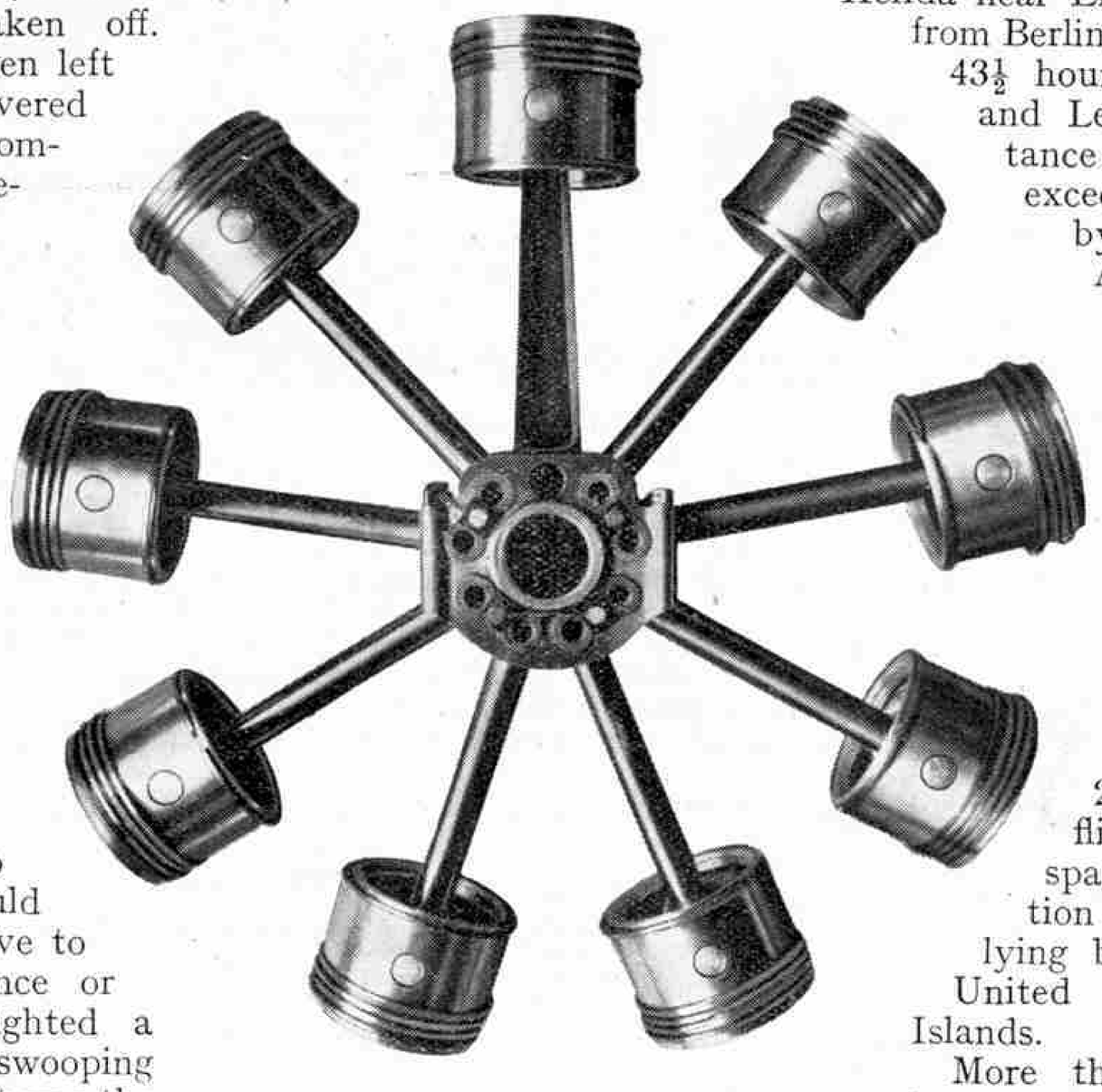
Within a fortnight of this memorable achievement the long-distance record set up was outdone by Clarence Chamberlin and Charles Levine, flying a "Bellanca" monoplane equipped with one "Whirlwind" engine. At dawn on Saturday, 4th June, 1927, the machine left Roosevelt Field, New York, where Lindbergh had taken off. New York had not long been left behind when it was discovered that the earth induction compass was running wild. Resource was made to an old magnetic compass, but this proved so erratic that the pilot had considerable difficulty in steering a course to Cape Race, the point selected for passing out over the Atlantic. The unreliability of the compass added greatly to the hazards of the flight, but it was decided to carry on with the hope of landing "somewhere in Europe."

As Sunday wore on the aviators speculated as to whether the land they would eventually reach would prove to be Ireland, England, France or Spain! Suddenly they sighted a liner westward bound, and swooping down to it they found that it was the "*Mauretania.*" They circled round the great vessel, noting the excitement on board created by their sudden appearance, and then mounted higher once more and continued their journey, while the "*Mauretania*" sent out wireless messages recording the meeting.

The meeting between the aeroplane and the liner took place about 300 miles west of Valentia, Ireland. As the machine sped onward again the two men consulted a copy of the "*New York Times*" that they brought with them. Turning to the shipping announcements, they calculated how many hours out the "*Mauretania*" must be, and then deduced that they must be nearing either Ireland or England. On Sunday night the machine was sighted over several places in Cornwall. Rough weather was encountered and it was found necessary to ascend to a height of 20,000 ft. to get above the storm.

Early on Monday morning the machine appeared over Dortmund, Germany, and ultimately was forced to descend on account of shortage of petrol at Helfda near Eisleben, about 100 miles from Berlin. Since leaving New York 43½ hours previously Chamberlin and Levine had covered a distance of 3,905 miles, thus exceeding Lindbergh's flight by 295 miles.

Another noteworthy flight was that of Lieutenants Maitland and Hegenberger of the United States Army, who, on 28th June, 1927, took off from Oakland, California, in a Fokker monoplane fitted with three "Whirlwind" engines, and 25 hours and 40 minutes later landed at Oahu, Hawaii Islands, 2,400 miles away. This flight marked the first spanning by air of that portion of the Pacific Ocean lying between the coast of the United States and the Hawaii Islands.



Connecting rods and piston assembled. The difference between the master rod and the eight link rods is clearly shown

More than 250 engines of the latest "Whirlwind" type have already been built and delivered to the United States Army, Navy and Coast Guard. The engines now being delivered for commercial service are identical with those furnished to the Government except that they embody certain minor changes indicated as the result of experience in the service testing of the Government engines. These new features are all designed to secure greater economy in fuel and maintenance. In particular, an improved enclosed valve gear secures economy by protecting the wearing parts from dust, sand and moisture, decreases the variation in valve clearance with temperature, and increases the length of time the valve gear can go without lubrication by hand.

The King of the Twilight World—

(*Continued from page* 570)

One silent night while the lake slept beneath the throbbing stars, the cold crept down and shackled it with ice. Ice held the quiet waters of the river's pools and draped itself in glittering festoons where the water danced against the rocks.

A strange listlessness overcame Angus. He no longer felt the lusty desire to work into the eye of the current and hang there with fins working quickly, eagerly on the watch for food. Only at mid-day did food interest him and even then not in the compelling way it had. He idled in deeper, slower water, and watched what food there was indifferently.

In late November snow fell for days. Branches overhanging the river sagged wearily under the load laid upon them until they could bear no more and their grotesque burdens fell without a sound, into the black hungry river.

When the storm was over, Angus turned tail to the current for the first time in his life and swam slowly downstream. Past the bend into waters strange to him, he went until half a mile down river he passed beneath a snow-covered log jam. The water was deep and quiet under the logs and in a hole scooped out by successive freshets he swung about. Below him, in twelve feet of water, lay several larger fish. But like him they were not feeding and he knew he was safe, for the dull indifference of winter was upon them all.

* * * *

This delightful little nature story is printed here by special permission of the Canadian National Railways, in whose Magazine it appeared some time ago—*EDITOR.*

Invitation to London Readers

Hamley Bros. Ltd. inform us that they have recently opened a new showroom floor at their premises, 202, Regent Street, London, W.1., which it is intended to devote entirely to boys. A scale model electric railway system, complete to the smallest detail, is arranged on one of the large scenic tables and runs with main line precision from one end of the Department to the other. Many things of interest to the model railway enthusiast are on view, from powerful scale model locomotives to miniature true-to-scale reproductions of platform accessories, etc. Messrs. Hamleys also cater for the model engineer and show a varied selection of parts and fittings for power plants and marine engines, as well as beautifully-finished models that all mechanically-minded boys will desire to possess. Another section is devoted entirely to wireless, where some specially interesting sets (and American apparatus unobtainable elsewhere in England) are to be seen.

Readers of the "*M.M.*" are invited to visit the premises and they will be shown round without any obligation to purchase. When you call, be sure to mention that you have been invited by the "*Meccano Magazine.*"

Aeroplane Registration Markings

So many readers have written to make inquiries on the subject within recent months that we feel sure that a brief statement relating to the conditions under which aeroplanes carry registration numbers and how such numbers can be identified, will be of general interest.

In the first place, every pilot who wishes to fly beyond a radius of three miles from his home station is required by law to carry identifying symbols consisting of five letters. The first of these letters indicates the nationality of the machine, and the remaining four are the letters of the individual machine; just as in British motor registration the letters indicate the county or borough, and the numbers those of the individual owner. Thus the letters G-AUAF indicate that the machine is of British registration, with AUAF as its identifying letters. Other countries carry other initial letters, N for United States, I for Italy, F for France, etc. Each country is allotted a group of letters one of which at least must be a vowel, and each machine registered by that country bears a combination of letters from that particular group.

There is no fixed size for the registration letters, but they must conform to certain requirements. Thus they must be in plain capitals of equal size, and must be spaced apart by a space equal to half the thickness of the individual letters. The width of each letter must be two-thirds of its height and the thickness of a single stroke must be equal to a sixth of the height of the letter.

In the accompanying table, which shows the international registration markings, it will be noted that in many cases several countries have the same initial letter. In such cases duplication of combinations is avoided by commencing the combination of four letters alloted to each country with a different letter, as shown in the table. Thus Switzerland has first the letter C followed by the letter H as the first of the combination. Portugal, Roumania and Uruguay also have the initial letter C, but in these cases the combinations commence respectively with P, R, and U.

Whenever possible a country that shares a letter for purposes of nationality mark commences its combinations with the initial letter of its own name.

Country	Nationality Mark	Identification Letters
United States	N	Combinations made with any letters of the alphabet, of which a vowel must be one. Y counts as a vowel.
Great Britain	G	
France	F	
Italy	I	
Japan	J	
Abyssinia	A	B as first letter.
Hedjaz	A	H " "
Nicaragua	A	N " "
Albania	B	A " "
Bulgaria	B	B " "
Chile	B	C " "
Lettonia	B	L " "
Bolivia	C	B " "
Cuba	C	C " "
Switzerland	C	H " "
Portugal	C	P " "
Roumania	C	R " "
Uruguay	C	U " "
Esthonia	E	A " "
Ecuador	E	E " "
Haiti	H	H " "
Hungary	H	M " "
Holland	H	N " "
Siam	H	S " "
Costa Rica	K	C " "
Finland	K	S " "
Czechoslovakia	L	B " "
Guatemala	L	G " "
Liberia	L	L as first letter.
Luxemburg	L	U " "
Monaco	M	O " "
Belgium	O	B " "
Peru	O	P " "
Brazil	P	B " "
Persia	P	I " "
Poland	P	P " "
Argentine	R	A " "
Sweden	S	A " "
Greece	S	G " "
Panama	S	P " "
Denmark	T	D " "
China	X	C " "
Honduras	X	H " "
Serbs & Croats	X	S " "
Danzig Free State	Y	M " "
Lithuania	Z	L " "
Spain	M	All the combinations made with A, B, C, D, E, F, G, H, I, J, K, L, M, or N, as first letter.

Blackburn "*Ripon*"

The Blackburn Aircraft Company, who are specialising in torpedo planes, have recently produced a new machine that registers a considerable advance over the well-known "Dart" type. The machine has been named the "*Ripon*" and is designed either for sea or land use, the land under-carriage and floats being interchangeable.

The "*Ripon*" is a two-seater 'plane fitted with a Napier "Lion" engine. The centre section of the main planes has been cut away to enlarge the field of vision of the pilot and of the observer, whose cockpits are both situated just at the rear of the main planes. The Handley-Page automatic slot has been fitted as standard to this type of machine, and it is probable that the device will be fitted to all new Blackburn machines in future.

Lighter Moments in the Air

A novel event was witnessed at the opening meeting of the British Motor Boat Club on the Welsh Harp at Hendon. Captain Barnard in a D.H. Moth endeavoured to "bomb" a fast motorboat with bags of flour. Fifteen minutes of excellent sport were witnessed and the spectators were amazed at the manœuvrability of the motorboat.

Events of this type are becoming increasingly popular. At a recent meeting of an air club an aeroplane endeavoured to "bomb" an Austin "Seven" which proved remarkably elusive, much to the delight of a large crowd. Bags of flour also are employed in the new sport of "aerial golf." In this, machines fly over a course and endeavour to drop the bags into circles marked in the ground. Each bag dropped counts as a stroke.

* *

New Seaplane Endurance Record

An American PN-12 Naval seaplane, piloted by Lieuts. Gavin and Soucek of the U.S. Navy, recently set up a new flight endurance record for seaplanes by remaining in the air for 36 hours 1 minute and 14 seconds. The previous record was 28 hours 35 minutes and 27 seconds.

* * * *

Aeroplane Parachutes

A most interesting experiment has recently been carried out in California. A pilot took an aeroplane up to a height of approximately 2,200 ft. and then stopped his engines. A small parachute was then released, and this in turn released a large parachute with a spread of 72 ft. In spite of the fact that the aeroplane developed a spin after the smaller parachute had opened, the larger parachute spread out and the machine was carried gently to earth.

Prairie-Pacific Air Line

A new Canadian air-line linking the prairie city of Winnipeg with Vancouver, on the Pacific coast, is under consideration. The suggested route lies via Saskatoon and Edmonton, at both of which stops would be made. Saskatoon does not boast an aerodrome at present, but is taking steps to acquire a suitable site, 160 acres in extent, close to the heart of the city. Winnipeg is the centre of the vast Canadian wheat-growing industry and such an air service would be of great benefit to its trade.

* *

America's Air Mail Service

In commemoration of the tenth anniversary of the opening of their first air mail service, the United States recently held an "Air Mail Week," to stimulate interest in aviation. Flying demonstrations and lectures were given throughout the Union.

The first regular air mail service in America was commenced on 15th May, 1918, between Washington and New York, and was operated by pilots and machines loaned by the War Department. From this small beginning there has grown a network of services that has expanded until to-day it covers nearly 10,000 miles of regularly operated route. The daily mileage flown exceeds 22,000.

On the first flight the weight of the letters carried was 10 lb.; the average daily total of mail matter carried now exceeds three tons!

* * * *

Hudson Bay Air Patrol

It is anticipated that there will be a considerable increase in sea-borne traffic in the Hudson Straits as the result of the opening of a new railway from the interior that will link up with Fort Churchill, on the Hudson Bay shore. With a view to assisting steamers to navigate the Straits it is proposed to establish three bases for Royal Canadian Air Force patrols.

The Canadian Government steamship "*Montcalm*" recently left for Hudson Bay carrying all the necessary equipment for the construction of the bases, and will remain in the Bay throughout the summer.

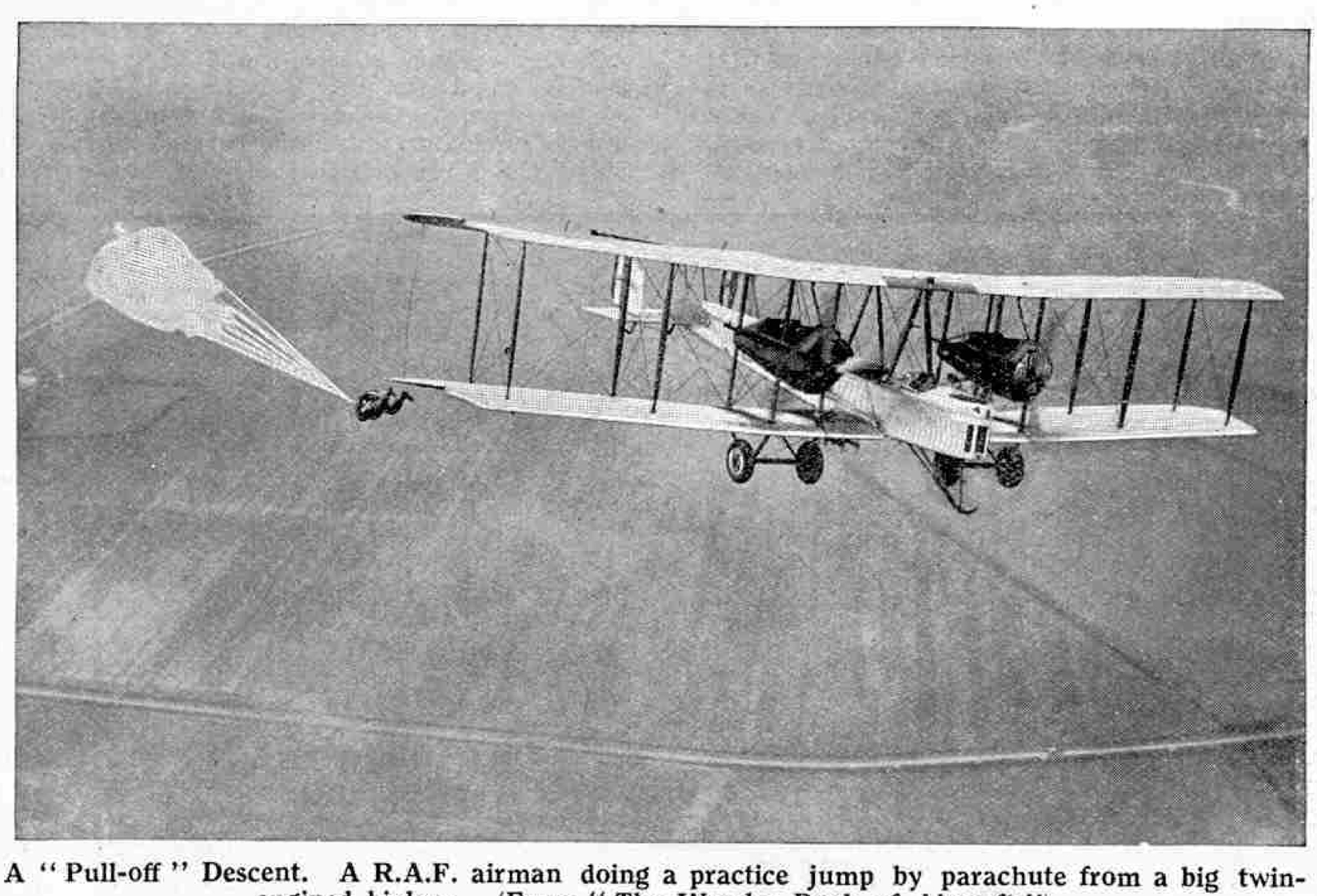
* * * *

Railway Company's Aviation Plans

The Pennsylvania Railroad Company are contemplating supplementing their existing passenger service by inaugurating a trans-continental aviation service, to meet the increasing competition that is being offered by aviation companies operating between the same points.

Canadian Air Mail Services

The experimental air mails that were operated in Canada last year proved to be such a success that four contracts for permanent services have been placed by the Canadian Government. Canadian Trans-Continental Airways Ltd. have secured two of the four contracts, one for a four-day-a-week service between Montreal and Father Point, and the other for a twice-weekly service between Montreal and Ottawa. Canadian Airways Ltd., and Canadian Colonial Airways Ltd., respectively, are to operate a four-times-a-week service between Montreal and Toronto and a daily service between Montreal and Albany, N.Y. The fare for these journeys has been fixed at approximately $1.25 (5/–) per flying mile.



A "Pull-off" Descent. A R.A.F. airman doing a practice jump by parachute from a big twin-engined biplane. (From "The Wonder Book of Aircraft")

* * * *

London-Moscow in 29 Hours

An arrangement between Imperial Airways Ltd., and the German Luft Hansa has made it possible for a traveller to leave London on a Handley Page Napier air liner at 8 a.m., and to be in Moscow within 29 hours. This service operates daily and is well patronised.

* * * *

3,000 Miles in Four Days

Recently two South African Air Force machines flew from Khartoum to Pretoria, a distance of 3,000 miles, in four days. They had accompanied the annual R.A.F. flight as far as Khartoum and decided upon the rapid return flight as a means of demonstrating the possibility of a six-days Cape to Cairo flight.

* * * *

Captain McIntosh, the well-known Imperial Airways pilot, recently made an exceedingly fast flight between Berlin and London, covering the distance of 600 miles in 4½ hours. The machine used was the Fokker "Jupiter" monoplane in which he and Mr. Bert Hinkler attempted to fly non-stop from England to India last year.

Canadian Aerial Surveying

The enthusiastic manner in which Canada has taken to the air is revealed by the report that during 1927 the Survey Section of the Royal Canadian Air Force took over 62,000 aerial photographs, covering an area of 45,850 sq. miles.

* * * *

Australia Aids Civil Aviation

Sir Alan Cobham has said that Australia is ideal for flying and capable of immense development by the use of aerial transport. The Australian Government apparently also realise the possibilities and have voted a sum of £200,000 toward the preliminary expenses of a number of new civil air lines that are to be opened up between Perth and Adelaide, Melbourne and Hobart, Charleville and Brisbane, and Sydney and Brisbane.

When this ambitious scheme of aerial highways matures, Australia will be encircled by air communications, and will possess aviation services one of the finest civil in the world.

* * * *

Airmen's Night Lights

A scheme for the systematic lighting of the principal airways is now being carried out on the Continent. At regular intervals (as far as possible) beacons are to be erected, each consisting of a number of Neon tubes giving an orange light. Stations will be distinguishable by a letter of the Morse alphabet that will be continuously flashed out by the beacon, thus enabling a pilot who is lost to ascertain his whereabouts immediately. It is thought that this system will satisfy a long-felt want for safer night flying for mail pilots.

* * * *

One-Man-Power Air Machine

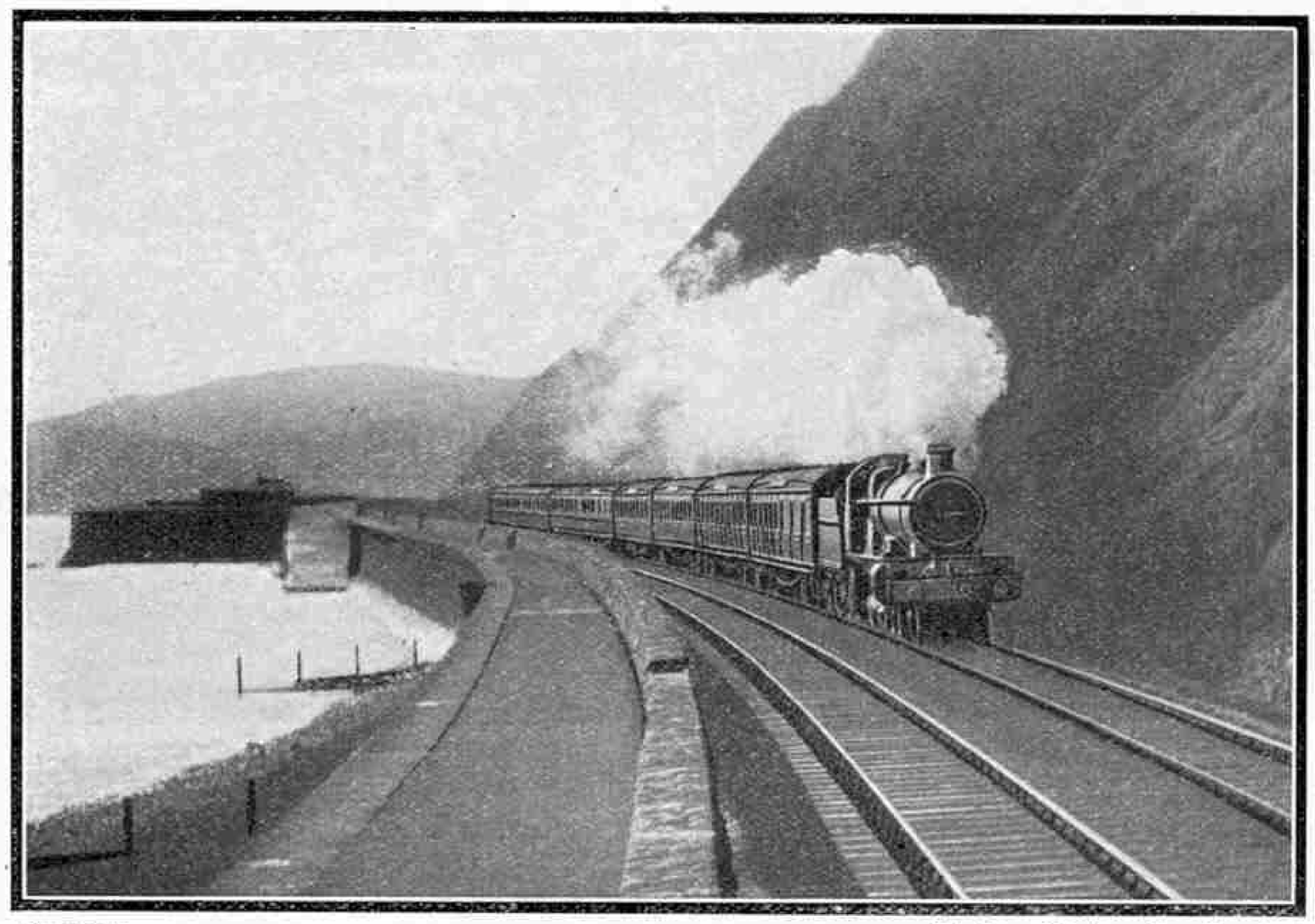
After a series of experiments lasting six years Mr. George R. White, an American airman, has evolved a one-man-power flying machine at St. Augustine, Florida. No official description of the machine is yet to hand, but in general design Mr. White's effort appears to be a smaller edition of the "*Pterodactyl*," reviewed in the "*M.M.*" for April, 1927. The wings are edged in a manner closely resembling feathers and they are constructed to flap in a similar manner to the wings of a bird. The machine is driven by foot power, and its inventor hopes soon to make an official trial flight which, if successful, will be the first flight made by a machine of this type.

FAMOUS TRAINS: XIX.

The "*Torbay Limited*," G.W.R.

By Cecil J. Allen, M.Inst.T., etc.

IT is a year and a half since we took our last trip over the West of England main line of the Great Western Railway, so that most of you probably will have quite forgotten what it looks like. Another reason why we should travel over this line again is that since that journey on the "*Cornish Riviera Express*," there have come into use over this route some of the most remarkable locomotives in the country. It was in July of last year that the first of the "Kings" took the road from Swindon Works, completely dwarfing the previous G.W.R. 4–6–0 engines, not excepting the "Castles." And not only so, but the "*King George V*," with a tractive effort of no less than 40,300 pounds, both held and still holds a substantial lead in tractive power over any other express locomotive type in this country, the nearest approach being the super-"Pacifics" of the "Enterprise" type on the L.N.E.R.



Courtesy] [*Railway Photographs, Liverpool*

The "*Torbay Limited*" passing the sea-wall at Teignmouth

What is the secret of this enormous tractive power? It lies chiefly in the use of a working steam pressure as high as 250 lb. per sq. in.—25 lb. higher than that employed on any other express locomotive type on the G.W.R., and far above the figure of 180 to 200 lb. so common on other lines. Since then the "Royal Scot" engines of the L.M.S. have been turned out with the same pressure, but owing to a considerably smaller volume of cylinders their tractive effort figure falls a long way below that of the "Kings." Ample cylinder power is always a feature of Great Western designs, and to this rule the "Kings" are no exception; dimensions of 16¼ in. diameter by 28 in. stroke, which apply to all four cylinders, witness to the long and narrow bore so well adapted to the Great Western practice of early cutting-off and ample expansion.

Another notable feature of the "Kings" is the way in which the adhesion weight—that is, the proportion of the weight of the engine coming down on the driving wheels—has been advanced above what was previously regarded as the safe maximum of 20 tons per axle. This maximum was fixed, of course, to keep within reasonable limits the weights coming down on the track and underline bridges. But recent experiments have proved that the worst harm to track and bridges is done by powerful two-cylinder engines. For certain technical reasons it is impossible fully to balance the forces set up by the heavy reciprocating and rotating parts of such engines when they are running at speed, with the result that with each revolution of the driving-wheels there comes a heavy impact, or "hammer-blow" on the track, which adds considerably to the effective weight coming down upon that pair of wheels. With a three-cylinder engine, however, and still more with a four-cylinder engine, conditions are vastly improved; in fact the four-cylinder engine virtually balances itself owing to the four cranks splitting up the circle into four equal parts of 90 deg. each. Thus it is that in all the latest British three-and four-cylinder express passenger designs axle-loads have been increased beyond the 20-ton figure. "*King George V*" heads the list with 67½ tons on the three coupled axles. Previously, or in existing conditions on the Continent of Europe, where the tracks are generally of strength inferior to our own, such a loading would have required eight-coupled driving wheels.

It is within the knowledge of most of you that "*King George V*" has already made a trip across the Atlantic to the United States and back, for exhibition at the "*Fair of the Iron Horse*," with which the centenary of the Baltimore and Ohio Railroad was celebrated last year. After going in solemn procession round the demonstration track in the fair-grounds at Baltimore, with many of the latest and most powerful American locomotive types—some of them up to twice the weight and size of our British representative, owing to the more generous limits of the American rolling stock construction gauge—"*King George V*" tried some running over American railroads, going from Baltimore to Washington and back in charge of the famous Old Oak driver William Young.

American rolling stock proved a tough proposition for a British locomotive, the twelve-wheeled all-steel cars weighing anything from 60 to 80 tons apiece, as against the 35 to 37 tons of the latest Great Western 70-ft. coaches. The British "King" did quite well with a train of nearly 700 tons, however, despite difficulty experienced in burning in the small British firebox the poor quality coal used on American locomotives. A maximum speed of 75 miles per hour was attained, and we are told, indeed, that Driver Young was peremptorily instructed to reduce this speed to a mile-a-minute and no more. Much capital was made out of this story at the time, as though our American cousins do not know what speed is, but this, of course, is far from the truth. The fact is that American railways are generally unfenced, that there are "grade crossings" innumerable—of railways over roads and over other railways as well—that not unfrequently they run up the main streets of towns, and that for these and many other reasons the main lines are infested with compulsory "reduce

Leading Dimensions of G.W.R. "King" Class Locomotives

Cylinders (four)	
Diameter	16¼ in.
Piston stroke	28 in.
Wheels	
Bogie, diameter	3 ft.
Coupled	6 ft. 6 in.
Boiler Pressure	250 lb. per sq. in.
Barrel length	16 ft.
„ diameter (outside)	6 ft. and 5 ft. 6¼ in.
Firebox length (outside)	11 ft. 6 in.
Heating Surface, total	2,514 sq. ft.
Grate Area	34.3 sq. ft.
Tractive effort at 85 per cent. B.P.	40,300 lb.
Weight of Engine in working order	89 tons
Weight of Tender in working order	46 tons 14 cwt.
Total weight	135 tons 14 cwt.

speed " orders, some of which, doubtless, were being approached at the time referred to. On other American routes, which I have not space to name, very tight bookings are in force, and speeds are attained little if at all inferior to those to which we are accustomed in this country.

But I am wandering far, I fear, from the "*Torbay Limited.*" Why "Limited"? "Limited" is a description of American origin, indicating passenger accommodation limited to a certain maximum number of places that can be booked in advance. Where strictly adhered to, this may mean that places on a popular "limited" express may have to be booked days in advance, or you may never get on to it on the day of your desire. In our own country the only true parallel is probably found in the "Pullman Limited" trains, such as the "*Queen of Scots,*" on which we travelled last month. It is only in the neighbourhood of Bank Holidays or at the busiest summer week-ends that the "*Torbay Limited*" becomes a real "limited express," as occasions have not been unknown when the first portion of the "*Torbay,*" made up to its maximum single-engine load, has gone out of Paddington with "booked seat" passengers only. But another subsequent train is always run for those who have not been so farseeing.

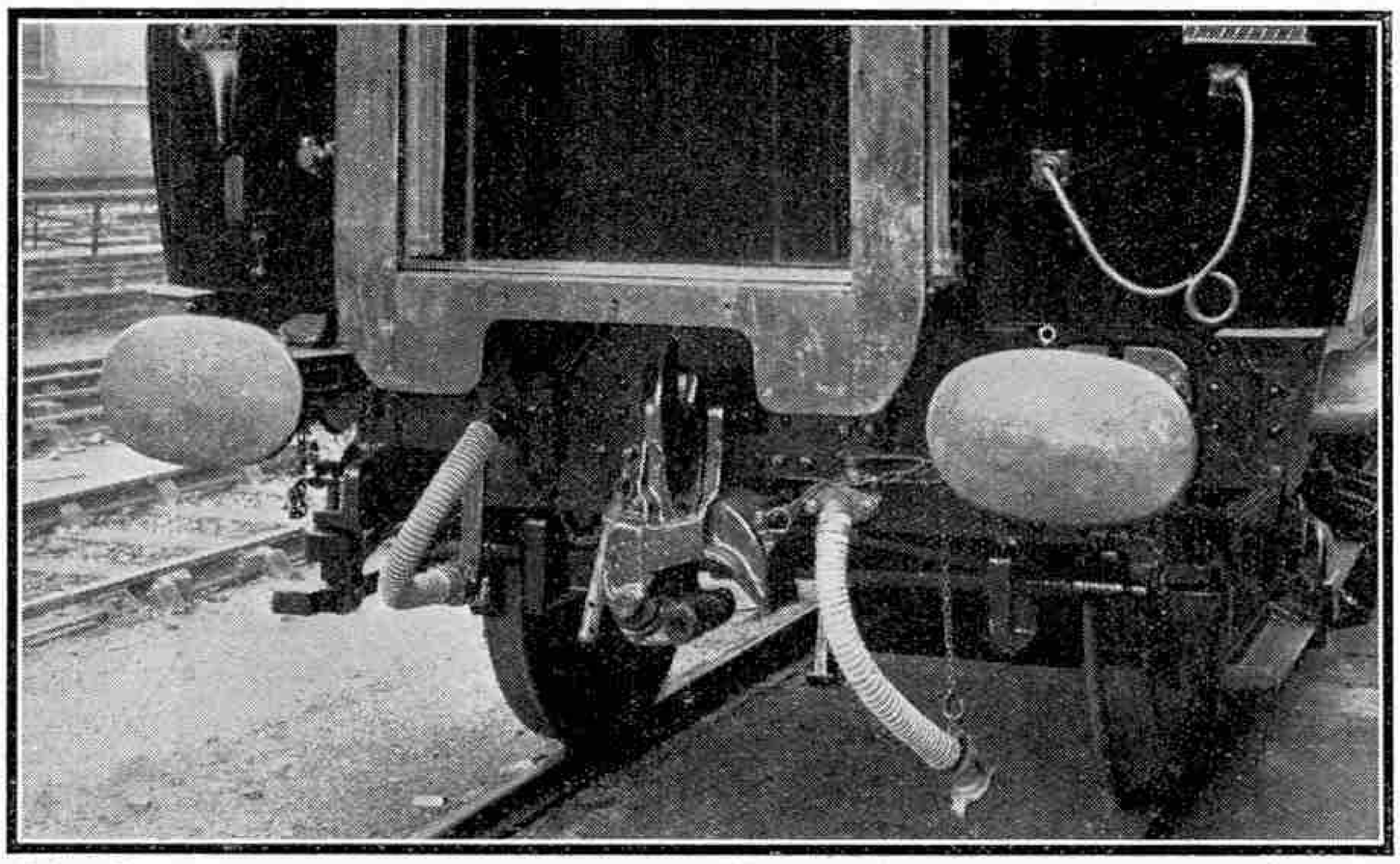
Torquay has much for which to thank the Great Western Railway authorities. All the year round the "*Torbay Limited*" brings the famous watering-place within 3 hours 35 minutes of Paddington, although the distance so bridged is 199¾ miles. When non-stop running is resumed, a week after you read these lines, the time will be cut to an even 3½ hours—the quickest ever yet scheduled between Torquay and London—involving an average speed throughout of 57 miles an hour. Exeter, 173¾ miles from Paddington, now reached in 175 minutes, will be passed in 174½ minutes, as in the case of the "*Cornish Riviera Express,*" and both trains are already timed to maintain an average rate of 60.4 miles per hour continuously over the 164¾ miles between Southall and this Cathedral City of the west. This I believe to be the fastest schedule in the world continued unbrokenly over so great a distance. It is not only Torquay that benefits by this lightning running, but also Paignton and Brixham, fringing Torbay, as well as Kingswear and Dartmouth, in the neighbouring Dart Valley.

A through portion to and from Plymouth is also run on both up and down "*Torbay Limiteds,*" detached on the down journey at Exeter and attached on the up journey at Newton Abbot. Coming to London the up "*Torbay*"—with the further addition at Brent of a through coach from Kingsbridge, which went down the previous day on the "*Cornish Riviera Express*"—makes a non-stop run of 194 miles from Newton Abbot to Paddington, missing Exeter. Owing to the longer time spent at Newton in marshalling the train, the up "*Torbay Limited*" requires 3¾ hours from Torquay to London, or 10 minutes more than the down train; but the allowance of 205 minutes from Newton to Paddington entails an average speed all the way of all but 57 m.p.h. Doubtless in the altered times that will operate from early in the present month, during the summer season, the up "*Torbay Limited*" will make the non-stop journey from Torquay to London in the same time of 3½ hours as the down train.

Photo] [*Railway Photographs, Liverpool*

Down "*Torbay Limited*" express leaving Paddington. Four-cylinder 4–6–0 locomotive No. 6012 "King Edward VI"

As we made our last West of England journey in the down direction, we shall get a new perspective of things on this occasion if we try the up "*Torbay Limited,*" and this means that we must betake ourselves to Dartmouth. Dartmouth is, from the railway point of view, singular in having a railway station but no trains. Between this station and the actual starting-point of the "*Torbay*" there stretch the waters of the Dart. So, though you take your railway ticket in quite an ordinary kind of booking-office at Dartmouth, a steamer journey across the river awaits you ere you find your train at Kingswear. Certain bridges between Paignton and Kingswear having been rebuilt recently, the heaviest engines are now permitted to work right through to Kingswear, and in the height of the summer it is quite possible that we may find our "King" heading the train from the start, in place of the humble 2–6–2 tanks which always previously performed the duty of haulage between Kingswear and Torquay, often hunting in couples to provide the necessary power over the steep intermediate grades.



Courtesy] [*G.W.R.*

Combined central buffer and coupling on latest G.W.R. coaches. When in use it rises to the horizontal position, and the side buffers, which are hinged, are dropped downwards

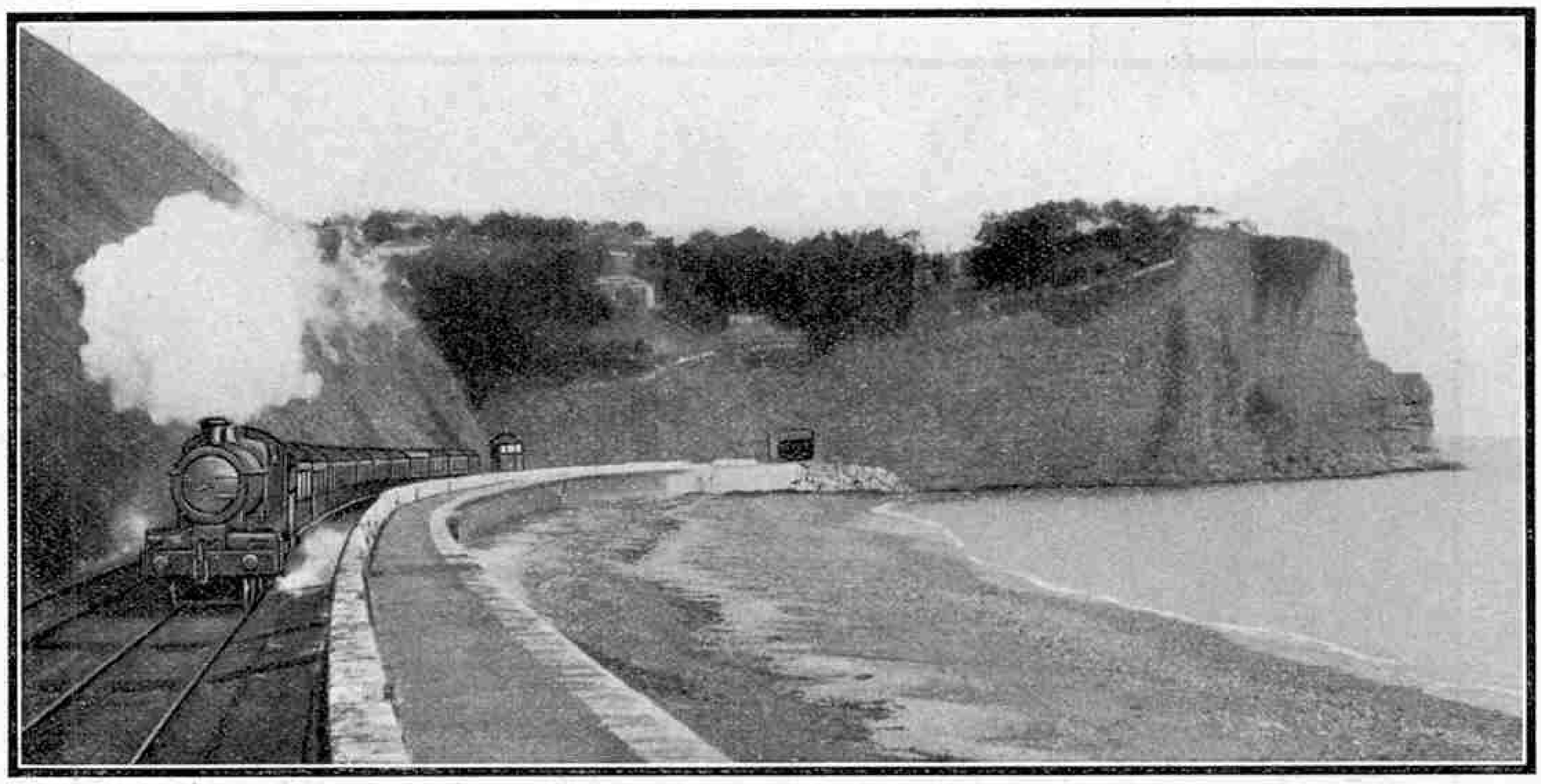
We have already made the acquaintance of some of the Great Western "articulated" stock, on our journey with the "*Birkenhead Diner,*" where we found an articulated restaurant car set in use. But here at Kingswear we see awaiting us a complete articulated train, in three "units," exactly similar to the one that the Great Western Railway ran in the Centenary Procession of 1925, when it was brand new. There is first of all a

"triplet," with a third-class brake, third-class corridor and another third-class corridor, carried on four bogies; then a "triplet-restaurant car set, with third-class open car, kitchen and first-class open car, again carried on four bogies; and a "twin" at the rear, with first-class corridor and first-class brake, carried on three bogies. Adjacent coach-ends are supported on a large steel casting, under which is pivoted the central four-wheeled bogie, on the lines of the Gresley patent used on the L.N.E. system. The empty weights of the three units are 78, 85 and 53 tons respectively, making a total of 216 tons.

Again we notice that, where the units are coupled together, ordinary side-buffers and a screw coupling are dispensed with in favour of a central combined buffer and coupling of the Gould type, the coach-ends being rounded in order to bring the two couplings closer together. The two "hands," as they appear when uncoupled, grip automatically as the coaches are pulled together, and not only provide a coupling of great strength but also hold the whole length of the train rigidly in line, and are one of the finest encouragements to smooth travelling that could be found. The L.N.E.R. have built up their reputation for perfect smoothness of travel largely on this invention, which they have had in use for nearly 30 years on their East Coast stock, and have now standardised in the building of all main line corridor coaches.

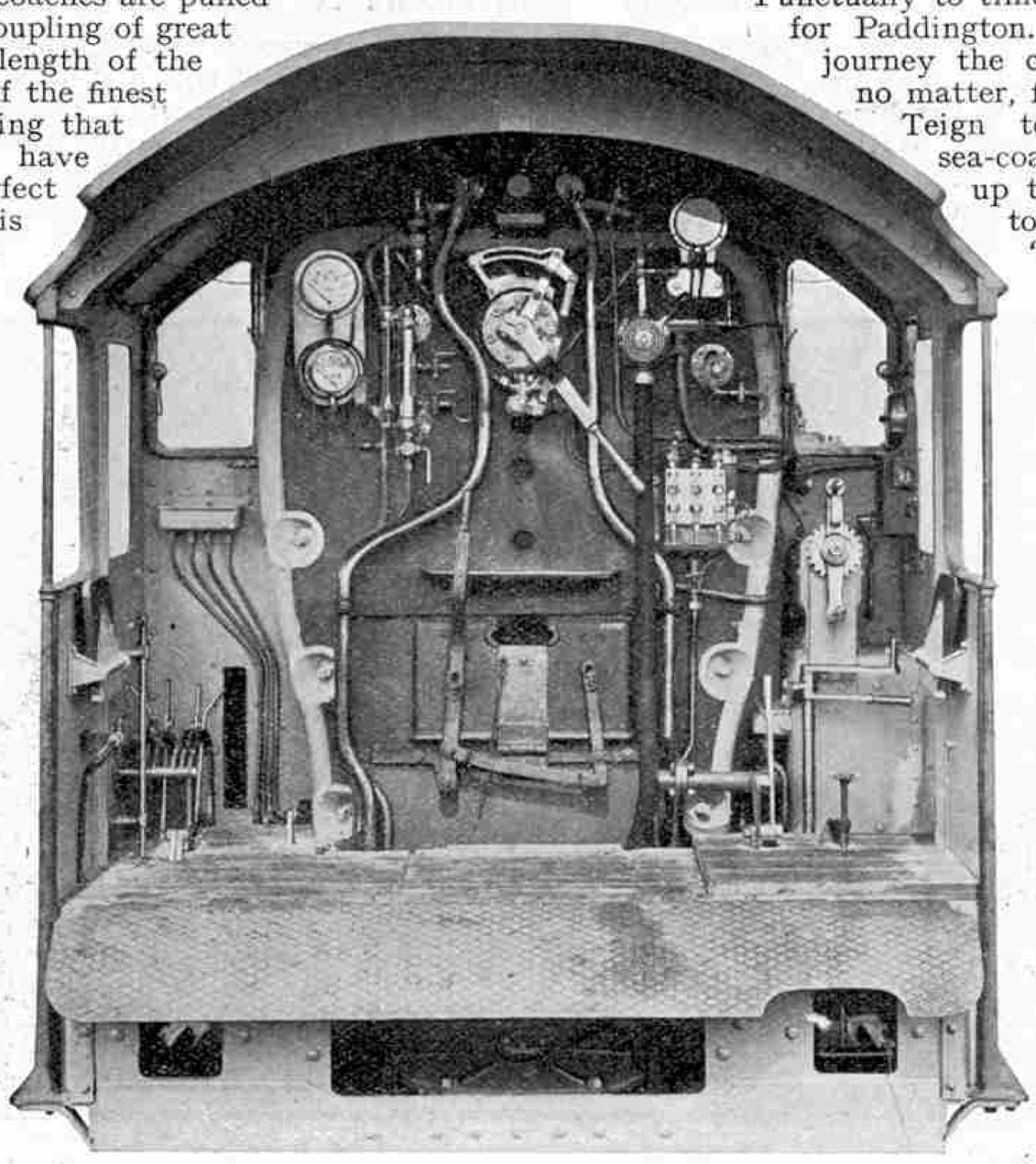
It is at 11.10 a.m. that our boat sheers off from Dartmouth Pier, and 15 minutes later, at 11.25 a.m. the "*Torbay Limited*" gets away from Kingswear. The speed of the first 14¾ miles of the journey, to Newton, is in striking contrast to that which follows. The time allowance, with three intermediate stops, is, in fact, 48 minutes, and the average speed less than 20 m.p.h.! But there is first a pull at 1 in 57 out of Kingswear up to the high ground of the neck of country separating the Dart Valley from Torbay. Then comes the stop at Churston Junction, where connection is made to and from Brixham; a stop at the rising watering-place of Paignton, and seven minutes' standing at Torquay. Last of all there is another steep climb out of Torquay, through Torre, as sharply inclined at one point as 1 in 53. As the full summer service has not commenced, too, it is probable that a 2–6–2 tank has had to handle the train as far as Newton Abbot.

Newton is reached at 12.13 p.m., and we find that the Plymouth and Kingsbridge portions have been in three minutes ahead of us. Probably these will add to the rear of our train not less than five 70-ft. coaches, weighing about 175 tons or so, so that our "King," which will most certainly take his place here at the head of the train, will have behind him a tare load of at least 400 tons, and a gross load reaching the substantial figure of about 425 tons. This is perhaps not excessive, according to Great Western standards, but none of it is to be slipped or detached *en route*, and it is clearly no feather-weight to whirl up to town at 57 miles an hour all the way. Before we leave Newton Abbot, by the way, we must find time to look at the wonderful manner in which the Great Western authorities have transformed the old, inconvenient and congested station into one of the finest stations on their system, with platforms of tremendous length and width, spacious station buildings, and a most comprehensive lay-out of track, sufficient to meet all developments of train service for many years to come.



Photo] [*Railway Photographs, Liverpool*

Down "*Torbay Limited*" express approaching Teignmouth. This section of the line has been blasted out of the rock, leaving on the landward side a magnificent wall of red sandstone



Courtesy] [*Great Western Railway*

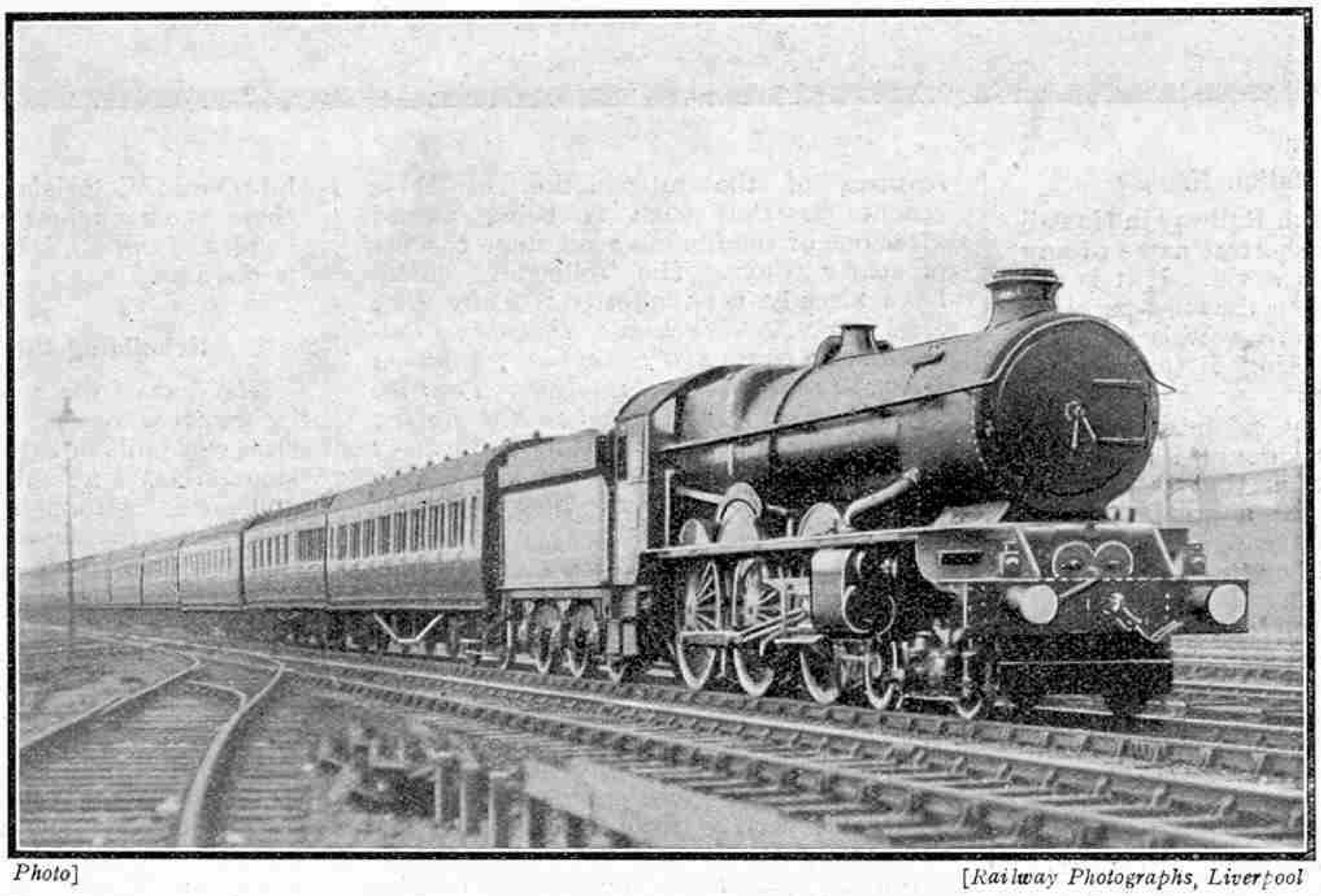
Cab of "King" class Locomotive

Punctually to time at 12.20 p.m. we head eastward for Paddington. For the first 20 miles of our journey the course is as near level as makes no matter, first down the tidal estuary of the Teign to Teignmouth, then along the sea-coast to Dawlish Warren, and then up the right bank of the Exe estuary to Exeter. But it is idle for our "King" to gather speed too rapidly, as for a good 10 miles, from this side of Teignmouth to beyond Starcross, the windings of the line round the coast are continuous and sharp, and no higher rate than about 50 m.p.h. is desirable. Successions of tunnels break up the stretch between Teignmouth and Dawlish, cut through the striking red sandstone rock of this coast, which at several points, seen from the line, has been weathered by the sea into singular shapes, such as the "Parson" and "Clerk." However, we clear Starcross at last, and taking a good draught of water from the Starcross troughs, our "King" picks up to 65 m.p.h. or so, ere the suburbs of Exeter indicate that it is time to close the regulator and slack for running through St. David's Station. We first thread the "all-over" roofed St. Thomas Station, and a moment later are clearing St. David's, at reduced speed, noting as we pass, very likely, a Southern express for Waterloo with its engine *facing* us, as the trains of the two companies pass through St. David's in precisely the opposite direction.

We have now roughly three hours, or a shade less, in which to complete the remaining 173¾ miles to Paddington. For the next 20 miles the gradients are against the engine. At first the

ascent is modest enough. Only for a mile beyond both Stoke Canon and Silverton does it get to as much as 1 in 207 and 1 in 222. But as we pass Collumpton the crests of the Mendips are coming in sight, and we get first a two-mile rise at 1 in 154 and then, after a brief drop through Tiverton Junction, 4½ miles up culminating in 2½ at 1 in 115, to Whiteball Box, just beyond Burlescombe. This 20-mile climb will probably not have taken our "King" more than 24 minutes. On the easier stretches speed may rise practically to the mile-a-minute mark, and the last grind up to Whiteball will probably bring us down to about 40 an hour or so. With a shriek the engine plunges into Whiteball Tunnel, under the summit of the ridge, and now it is up to our driver to maintain a mile-a-minute average speed throughout to the point of first slowing down for the Paddington stop.

Wellington bank gives him a good start. Beginning at Whiteball Box, this famous descent extends nearly to Taunton, and is very steep for the first four miles to Wellington Station, including as it does 2¼ miles at an average of 1 in 85. It was on this racing-ground that May 9th, 1904, witnessed the fastest authenticated railway speed that this country has ever known, the 4–4–0 engine *"City of Truro"* attaining no less than 102½ miles per hour with a mail special from Plymouth to London. We need not expect any speed approaching this, but something well over 80 miles an hour is quite possible, and very fast travelling will continue on past Taunton. It is 31 miles from Exeter to Taunton, and these will have taken us, probably, 33 minutes or less.



Photo] [*Railway Photographs, Liverpool*

Four-cylinder 4–6–0 locomotive, No. 6005 "King George II," hauling the up "*Torbay Limited*"

Shortly after Taunton our "King" gets a second welcome draught of water, at Creech troughs, and then there will probably follow a slight easing of the speed for the junction at Cogload. This is where we leave Brunel's old West of England main line, five miles beyond Taunton, for the shorter Westbury route. Notice how the straight original up and down lines have been spread out from each other at Cogload, in order to allow the laying in of a fast-running junction that we can take with perfect safety, even in the facing direction, at 60 miles an hour. From Cogload we cut at speed across the marshes of Sedgemoor and then rise on to the higher ground beyond, nowhere very steeply, threading a long tunnel near Somerton, and joining the old Berks and Hants line, on its way from Weymouth and Yeovil, at Castle Cary.

The character of the line now changes. For miles it is very winding, and for seven miles beyond Castle Cary it is steep as well. With short interposed "steps" of level track, it rises chiefly at 1 in 98 until we breast the signalbox at Brewham, the actual summit being marked by mile-post 122¾. This distance of 122¾ miles is not, of course, by our route, but by the old route from London via Chippenham. As we pass the summit we are but 108 miles from Paddington. The downward run to Westbury is not made at high speed because of the windings, and is broken into by a very severe slack round the curve at Frome; both here and round Westbury curve a reduction to 35 m.p.h. is imperative. Between the two the tender is replenished for the third time, from Westbury troughs. Owing to these various hindrances it is quite possible that the 47¼ miles from Taunton to Westbury may have taken us 51 or 52 minutes, and good going at that, too. If the latter, we have now left but 95 minutes for the remaining 95½ miles to Paddington.

Once again a long rising stretch of line lies ahead—25½ miles of it; but the only appreciable grades are the six miles up at 1 in 222 from Lavington, and the last six miles up to Savernake, at much the same inclination, broken intermediately by a level strip. The first 7½ miles out of Westbury are, however, virtually level, and allow our driver to top the mile-a-minute rate without difficulty. Up to Patney we then fall to 50, probably, and with a further maximum, very likely over 60, in the dip between Woodborough and Pewsey, we breast Savernake Summit at something a little over 50 an hour, possibly 55. Despite the ascent, our "King" has quite likely run the 25½ miles from Westbury in 27 minutes.

Only 68 minutes now left for the 70 miles to Paddington! Can it be done? With ease; all the hardest work is now over. For the next 31 miles there are nothing but falling grades, and although the winding character of the track prevents our "King" from laying himself out to the maximum of his possible efforts, we can count on an average of 70 miles an hour for miles on end. Water is taken for the fourth and last time from Aldermaston troughs, and seven miles later there comes the slowing for the first of the Reading Junctions — Southcote —ere we sweep round on to the old main line again at Reading West Junction. The 34 miles from Savernake have been covered in 31 minutes, and 37 minutes for the remaining 36 level miles is "easy going" by Great Western standards! So we hurry on past Twyford, Maidenhead, Slough—going once again at 70 an hour, probably—Southall, Acton. Then the regulator is closed, and we drift on past Old Oak and Westbourne Park into Paddington, arriving very likely with a minute or two in hand on our schedule time of 3.45 p.m. And we think, as we take our last look at the "King," that these wonderful Great Western engines must be capable of flying on at these speeds pretty well for ever!

"A Book to Read"—(*continued from page* 587)

Perhaps the most remarkable flights described in this book are the tours undertaken by Sir Alan with Mr. Lucien Sharpe, who must rank as one of the pioneers of civil aviation on account of the persistence with which he made these aerial journeys. They were not only extensive in regard to the distance covered, but were remarkable also for the length of time during which the machine was in continual use, and for the lack of any preparation beforehand. On one of these tours, which ranked at the time as a world's record, over 12,000 miles were completed with the same aeroplane and engine. To use Sir Alan's own words, he and his passenger "just wandered over the skies through Europe into African deserts, the Holy Land and the wonders of Egypt—anywhere, in fact, we thought we would like to visit." On journeys such as this an engineer was taken to relieve the pilot of the work of keeping the machine in condition.

One chapter of the book illustrates in a most remarkable manner the enormous scope of the aeroplane. In it the author describes a flight from London to Africa, a distance of 1,250 miles, in one day. This feat was successfully accomplished between 6 a.m. and 7.30 p.m. The flight was also noteworthy as the first distance flight on which Sir Alan was accompanied by A. B. Elliott, the engineer who had been with him when he won the King's Cup, and who later met with a tragic death during the famous flight to Australia.

Sir Alan Cobham has been described as "the Columbus of the air," and as the most widely travelled and adventurous of airmen he fully deserves the title.

The Shortest Station Name?

A station on the Oahu Railway in Hawaii claims to possess the shortest name of any railway station in the world. If it is not the shortest it certainly is the most peculiar, for both its letters are vowels and are identical, the name being Ii (pronounced ee-ee).

The Oahu Railway is interesting in several respects but one of its greatest claims to distinction is that it employs automatic signalling to a greater extent than any other 3 ft. gauge line. Over one-third of its total length of 70 miles is automatically signalled.

While on the subject of interesting railway names, mention must be made of the recent choice of Tadmor as the name of a new goods yard on the Lehigh and New England Railway in Eastern Pennsylvania. The name is remarkably appropriate, for those who have studied their Bibles will identify the original Tadmor as a city built by King Solomon to further commerce with the North and East. The new Tadmor, of course, is designed to facilitate industrial transport.

Eastern Pennsylvania is famous for its adoption of Biblical names for its cities and towns, as instance Bethlehem and Nazareth.

* * * *

New Southern Programme

Approximately £1,000,000 is the estimated cost of the additional locomotives and rolling stock to be built by the Southern Railway during 1928. The greater portion of the work is to be carried out at the Company's own depots at Ashford, Brighton, Lancing and Eastleigh. The last-named depot is already hard at work on 38 new locomotives of which 10 are to be of the "Nelson" class, and it is anticipated that several of these will be available for the long distance summer express services. At Eastleigh also several new sets of corridor coaching stock are being built for the "*Atlantic Coast Express*," the Southampton boat trains and other main line services.

Ashford works are engaged principally on 12-ton goods wagons of which 1,650 are to be built.

* * * *

L.N.E.R. Rail Coaches

The L.N.E.R. recently completed the placing of the orders for their new fleet of 50 Sentinel-Cammell and Clayton rail coaches that are to be used at various points of the system, principally where intense services are required for special purposes in districts that are not yet ripe for development on ordinary lines. One of the most interesting features of the introduction of these coaches is that each is being named after one of the famous road stage coaches of early days. The following names have already been allotted: *Tally Ho; Highflyer; Rockingham; Phœnix; Perseverance; North Star; Neptune; Liberty; Hero; True Briton; Trafalgar; Transit; Teazle; Rob Roy; Rapid; Red Rover; Royal Sailor; Yorkshire Hussar; Wonder; Wellington; Express; Union; True Blue; Rodney; Eclipse; Ebor; Comet; Bang Up; Chevy Chase.*

* * * *

Engine Nicknames

An interesting correspondence has recently taken place in the "*Railway Magazine*" regarding nicknames given to locomotives. One correspondent writes as follows:—"In the early days of locomotives each was given a name, a practice, no doubt, derived from their rivals, the coaches. In those days there were seldom two alike, but later, when three or four or more similar engines were built, they were referred to collectively by the name given to the first of the class, or, perhaps, according to the main theme of nomenclature, for example, *Star* class."

The correspondent goes on to refer to the study of these names, but confesses that in his opinion the nicknames are more interesting, and one is inclined to agree when one encounters examples such as "*The Gobblers.*" This was the name applied to the 2–4–2 tanks of the G.E. section that were built to Mr. Worsdell's designs in 1883. These engines had an amazing appetite for coal, and hence the name! On the G.E. section also the 999 class of 0–6–0 goods engine were referred to as "*Waterburys,*" possibly because when running with steam shut off the motion made a noise which, with a stretch of imagination, resembled a clock. Engines of a somewhat larger class of the same type on the G.N. section were called "*Knick Knacks*" for a similar reason, while the corresponding class on the old G.C.R. were called "*Pom Poms,*" from the sound of their exhaust beats.

The G.C.R. "*Atlantics*" built at the beginning of the present century were considered so graceful that they are to this day referred to as the "*Jersey Lilies,*" after the celebrated Lily Langtry. Later, mention is made of the G.C.R. 2–8–0 class, so widely known as the standard R.O.D. engine, which, because they seemed so large in comparison with other engines, were affectionately dubbed "*Tiny,*" a name that has remained. The 0–6–0 passenger tanks of the G.E.R. were called "*Jubilees*" because they made their first appearance in 1897, the year of the late Queen Victoria's jubilee. Incidentally, these same engines were also known as "*Buck Jumpers,*" the reason for which is obvious.

* * * *

Rebuilding the "Claughtons"

The first of the now well-known express locomotives of the 4–6–0 "Claughton" class was built in 1914, and several of these locomotives were subsequently turned out at Crewe. Although the class as a whole has been a favourite with the enginemen, and has done notable work, it has been the opinion of keen observers that the original boilers, with their comparatively low steam pressure of 180 lb. per square inch, were not sufficiently powerful for the four high-pressure cylinders. One of the type, No. 5999, "*Vindictive,*" has now been rebuilt with a larger boiler and 200 lb. pressure, and it is expected that in service this engine will prove a big advance on her sister engines, and will even vie with the latest "Royal Scots." The general appearance of the rebuilt locomotive is neater and more impressive, and her exploits will be eagerly watched.

Another "Claughton," "*Sir Alfred Fletcher,*" has been running for a considerable time with Caprotti patent valve gear, and although considerable economies have been stated to result from this system, apparently no others of the class are to be so fitted.

* * * *

A "Royal" Tank Loco on the L.M.S.

One of the latest type of 2–6–4 passenger tank locomotives of the "2300" class now bears the name "*The Prince*" on its side-tanks. The engine in question, No. 2313, was inspected by the Prince of Wales upon the occasion of his recent visit to Derby. No. 2313 is painted in the new standard black livery with red lining, and is working with seven others of this class in the Manchester area. This is the only instance of a named tank locomotive on the L.M.S. and it is not intended to name the other engines of the same class.

* * * *

Ten Miles to Turn!

One of the latest 2–6–0 class of L.M.S. locomotives runs to Fleetwood daily from Manchester, and at present has to run light for no fewer than 10 miles in order to turn for the return journey. As there is no turntable at Fleetwood long enough, the "Mogul," after its train is shunted out of the terminus by another engine, runs backward to Poulton Junction, traverses the loop line at that point, and returns to Fleetwood tender first again, a total distance of 10 miles.

R.S.M.

Utility Vans

The Southern Railway have brought into service a new type of goods van to be known as "utility" vans, for work with fast trains on any section of the company's system. As the name suggests, these vans will be available for a great variety of purposes, such as the conveyance of milk, freight, motor cars, road vehicles, light guns, aeroplane parts, scenery and luggage. They will be economical in operation as they will be constantly in service, thus avoiding the delays that hitherto have arisen in procuring special rolling stock to deal with traffic requiring peculiar loading facilities.

The vans weigh approximately 14 tons and are registered to carry a distributed load of 10 tons. A particularly interesting feature is that, in addition to side folding doors, hinged double doors in conjunction with a bottom drop flap are provided at each end of the vans for loading road vehicles and large cases.

* * * *

One of the afternoon trains on the Paris-Bordeaux line is now equipped with wireless receiving apparatus, for the use of passengers. There are 60 sets of headphones available, and it is stated that messages come through with exceptional clarity outside the electrified section of the line. It is proposed to introduce similar equipment on other trains in the near future.

* * * *

The Manchester Tube Railway

In our issue of January last we gave brief details of the proposed electric underground railway scheme for Manchester that for some time past has been occupying the attention of a special committee of the Manchester Corporation. An alternative scheme has now been presented for consideration. This provides for the construction of an inner circular railway linking the chief railway stations in the city, instead of the original proposal for an inner circular railway and an outer line ringing the suburbs. Obviously the main idea of the new scheme is to provide quick cross-city transit for passengers desiring to get from one terminus to another, thus avoiding the traffic congestion on the road level in the centre of the city.

* * * *

Diesel Electric Trains

In the middle of April trials were conducted on the L.M.S. railway between Manchester and Blackpool with a Diesel-electric train, the first of its kind seen in Great Britain. The power unit is built into the leading coach and consists of a 500 h.p. Beardmore-Diesel engine driving electric generators which, in their turn, supply power to the traction motors. The engine is run on crude oil and a train of average weight can be hauled at a speed of from 50 to 55 m.p.h.

The leading coach was built by the English Electric Company, Preston, who have contracts in hand for three similar trains for Venezuela and three for Spain.

* * * *

Motors Replace Horses

The Southern Railway have decided to substitute motor lorries for approximately 100 of the horse-drawn vehicles that hitherto they have operated in the outer London areas and in certain country districts. However much one regrets the passing of the horse, one recognises that in districts where long journeys have to be undertaken, or where delivery areas can economically be extended, the motor vehicle has a great advantage.

In spite of the growth of petrol and steam traction, at the end of 1926 there were still more than 19,000 horses employed by the four big railway groups. Of these, just under 1,000 were employed on shunting services, while 18,400 were engaged on parcels and goods traffic. The number of horses employed in 1913 was over 26,000 and thus it will be seen the companies have been slow to dispense with their equine employees. The view taken is that in towns where journeys are short, and stops both frequent and lengthy, the horse-drawn vehicle is far more economical than the motor.

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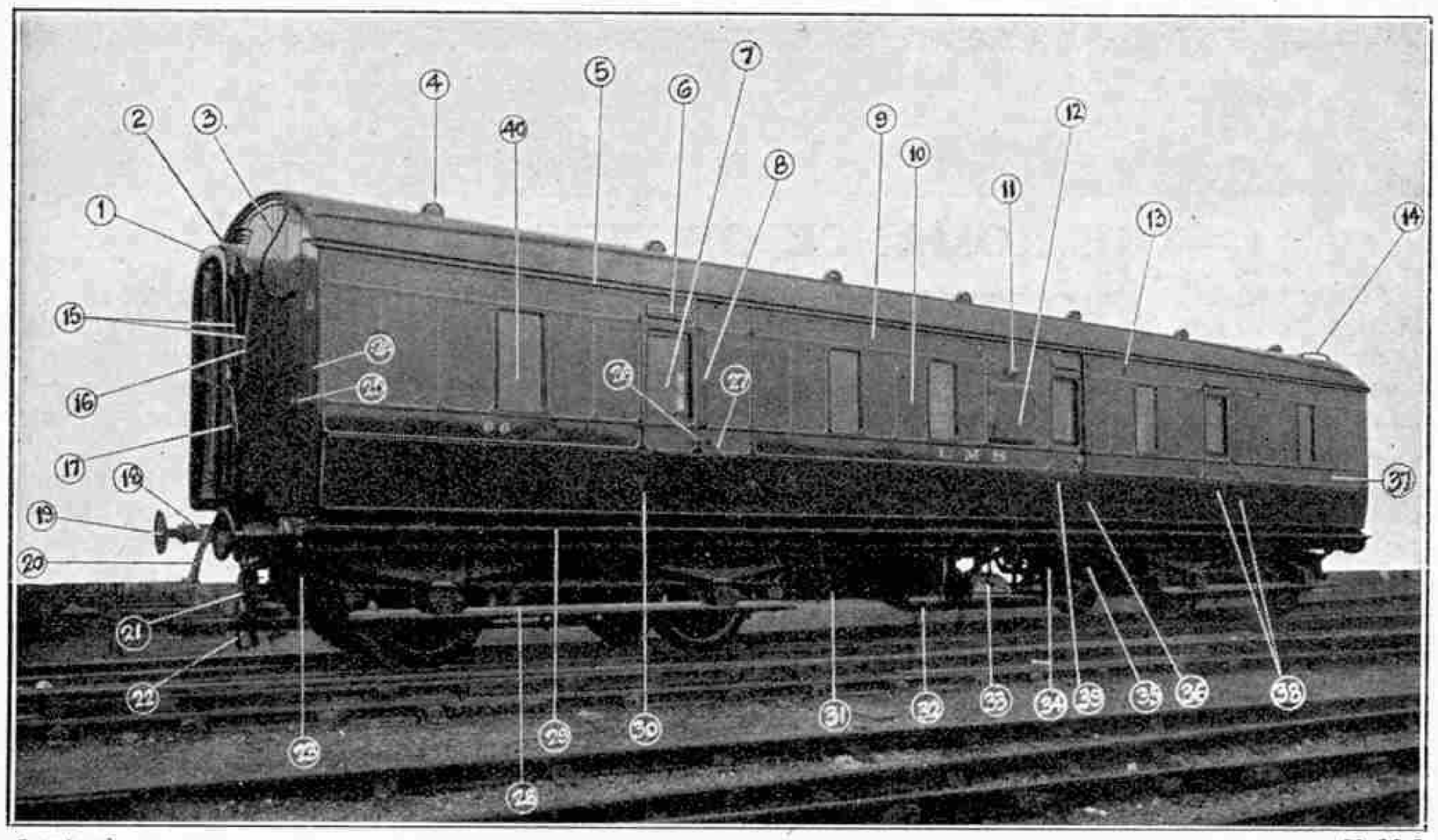
NEW L.M.S. ROLLING STOCK:—BOGIE BRAKE VAN



Courtesy [*L.M.S.*

1 Gangway Front Plate; 2 Gangway Hood; 3 Electric Light Through Control Coupler (L.N.W. Type); 4 Roof Ventilator; 5 Outside Cornice; 6 Door Bonnet; 7 Door Light; 8 Guard's Door Commode Handle; 9 Top Panel; 10 Upright Panel; 11 Side Lamp; 12 Guard's Projection; 13 Destination Board Bracket; 14 Roof Commode Handle; 15 Gangway Lazy Tongs; 16 Gangway Retaining Hooks; 17 Gangway Grip Lever; 18 Buffer Guide; 19 Buffer; 20 Vacuum Brake Hose Pipe and Coupling; 21 Warming Apparatus Hose Pipe and Coupling; 22 Screw Coupling; 23 Check Chain; 24 End Commode Handle; 25 Electric Light Through Control Coupler Base (R.C.H. Type); 26 Door Handle; 27 Outside Handle for Luggage Door; 28 Bottom Step Board; 29 Top Step Board; 30 Door Hinge; 31 Cell Box; 32 Truss Bar; 33 Electric Light Regulator; 34 Rocking Shaft; 35 Vee Hanger; 36 Guard's Door Commode Handle (Bottom); 37 Waist Panel; 38 Luggage Doors; 39 Guard's Door; 40 Quarter Light.

Railway Clocks Synchronised by Wireless

The Italian State Railways are now employing radio signals for the checking of all clocks on their system. Wireless receiving apparatus has been supplied to the headquarters of each of the 14 "districts," and connections made to the ordinary railway telegraph apparatus. When the Paris and Nauen time signals are given they are picked up and automatically relayed to all stations along the line.

* *

L.M.S. Non-stop Record

The L.M.S. reply to the new L.N.E.R. non-stop run over the 392 miles separating King's Cross and Edinburgh, announced in the last issue of the "*M.M.*," was not long delayed, in fact it was accomplished before the L.N.E.R. run came into being. On Friday, 27th April, the necessity for running the "*Royal Scot*" in duplicate arose, and separate portions for Edinburgh and Glasgow, respectively 399¾ and 401½ miles from Euston, were put on. Each accomplished its journey without a halt, thus setting up a new record for the world's longest non-stop railway run. The Edinburgh train was worked by a 4-4-0 compound and the Glasgow train by a "*Royal Scot*," each engine having a crew of two drivers and one fireman.

* * * *

London-Paris Service Speeded Up

To compete with the cross-Channel air service between Paris and London, the railway companies controlling the railway and boat services between London and Paris have decided upon a cut in the time schedule. A new service is to be introduced leaving Paris at noon and arriving at Victoria at 5.30 p.m. The Paris-Calais run will be made non-stop. The Channel crossing is to be made in 55 minutes and the boat train from Dover is timed to depart only 10 minutes after the boat's arrival.

THE STORY OF OUR DAILY BREAD

BY
W. COLES FINCH

I.—THE ROMANCE OF WHEAT-GROWING

THE expression "our daily bread" is one with which we are familiar from early childhood, but perhaps few of us realise that bread is one of the chief distinguishing marks of civilisation. There is little doubt that the early human beings remained for thousands of years either food gatherers or food hunters, their diet consisting of fruits, nuts and berries found growing wild, or the flesh of animals and fish caught and killed. This mode of life made it necessary that the families or tribes should leave one district as soon as its sources of food supply began to be exhausted, and move on to fresh hunting and gathering grounds. As a result a fixed home was impossible, and there were distinct limits to the numbers of the race.

Traces of this state of affairs may be seen in many parts of the world to-day. The Eskimo, for instance, is dependent for his very existence on fish and seal meat. The Indian tribes of Northern Canada live mainly on the caribou. These animals are killed during their annual migration, when they usually follow a definite track to the south. If they are not met with on their usual course the tribes send out scouts to find them and report to the hunters. If the caribou fail to appear at all, then the position of the Indians is serious, and they would be faced with famine and death but for the steps that are now taken by the Canadian authorities to provide for them.

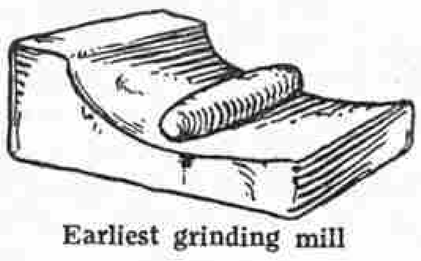
Typical ears of barley, wheat and oats

Typical food-gatherers are to be found in the South Sea Islands, while on a somewhat higher scale are the nomadic tribes of Central Asia, some of which have never advanced further than the discovery that food animals may be domesticated. For ages these animals have been fed on natural herbage, and as the food available in one area has become exhausted the tribes have moved on in search of fresh supplies.

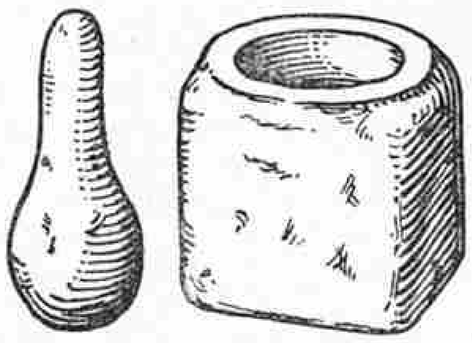
Real civilisation may be said to have begun with the discovery of methods of cultivating food plants. There is some difference of opinion regarding the place of origin of corn growing, but all the indications seem to point to Egypt, or Sumeria, the name given to the lower part of what is now known as Iraq. In both countries a really advanced civilisation flourished at a very early period. In each case a large river is concerned. The Nile and the Euphrates wash down into the plain the silt from the mountains in which they rise, and periodically they overflow their banks, thereby irrigating the soil. The fertility of the valleys in these regions is due to the existence of the rivers, and the lands through which they flow almost certainly saw the beginning and growth of agriculture.

In the case of Egypt the floods on the Nile take place at a definite season of the year. Owing to the fact that several months elapse between the heavy rains in Central Africa and the floods that they produce in Egypt, the effect as regards food growing is felt only in the coolest of the Egyptian season, that is the one best suited to the growth of grain. The dwellers on the banks of the great river and in the districts irrigated by it would not find it difficult to realise that the seeds of certain plants sprouted after the annual flood and ripened after a definite period of growth. From this realisation it would be only a step to the idea of planting seed with the prospect of reaping a harvest after a few months.

It was in this manner that Egyptian agriculture grew until in Roman times Egypt was the granary of the world. The antiquity of agriculture in the country is shown by the fact that the glumes of a type of barley have been found in the stomachs of mummies from a pre-historic settlement named Nag-ed-der. In all probability barley was the first grain to be cultivated in Egypt, while wheat seems to have appeared first in Sumeria.



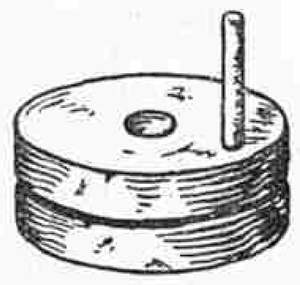
Earliest grinding mill



Earliest form of mill in which grain was simply crushed

There appears to be ground for believing that the culture which grew up around this first agricultural community spread itself over a large portion of the earth. The people who developed it searched for gold, tin and pearls, and this search led them along the shores of the Indian Ocean and from there across the Malay Archipelago to the South Sea Islands. Traces of culture of the same kind are to be seen in ruined buildings, in beliefs and superstitions still surviving, and in the relics of old methods of cultivation by irrigation that are found along the trail of these ancient people. The hotter clime of the southern islands was unsuited to wheat growing and there a plant named taro was cultivated.

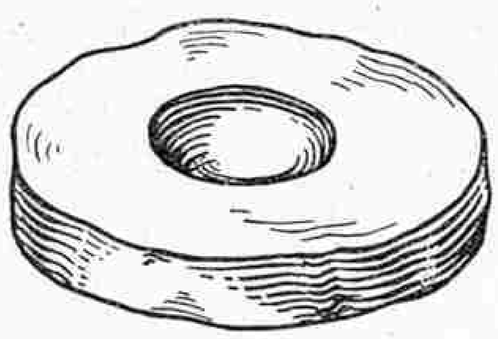
In many places immense ruins and mysterious statues have been discovered, the origin of which is entirely unknown to their present inhabitants. They are found even on lonely Easter Island, an outpost of the South Seas towards South America, and undoubtedly they point to the existence there in past times of a higher civilisation.



Primitive grindstones

The spread of this ancient culture is not so

closely connected with the story of our daily bread as to warrant following it any further, except to note that one explanation of the origin of civilisation in Great Britain is based on it. It has been suggested that wanderers from the Mediterranean countries found their way to Britain by way of the shores of Spain and France. It is certain that there was an intimate connection between these countries and the southern shores of Britain at a very early date, so that colonists, traders, invaders or whatever they were, entered Britain by Dorset and Cornwall. They mined tin and lead, and probably were the people who erected the great buildings the ruins of which are now to be seen at Avebury and Stonehenge.



Hollow crushing stone

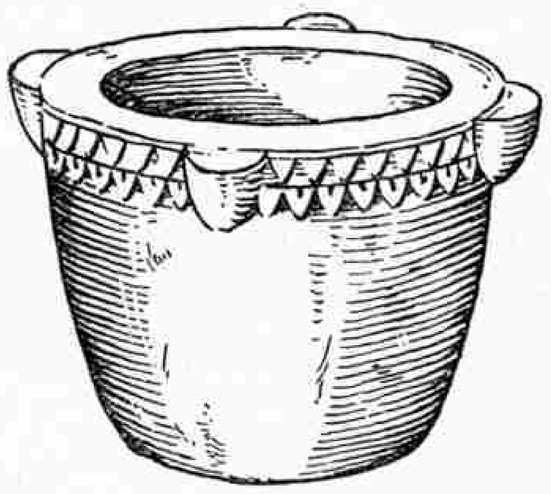
The theory that civilisation in Great Britain was developed directly or indirectly from Egypt may seem a little fantastic, but it is by no means improbable. In any case it is clear that the inhabitants of ancient Britain were not painted and ignorant savages. They certainly shared in the advance brought about by the discovery of the methods of cultivation of food plants, however this knowledge reached them. The Greek traveller Pytheas visited this country three centuries before Cæsar landed in B.C. 55, and was impressed by the wealth of corn, while a later writer noted that the harvest was gathered by cutting off the ears of corn and storing them in underground granaries.

A picturesque but obsolete reaping method

Turning now to the wheat plant itself—the aristocrat of the grain world—it has been noted already that this probably originated as a cultivated plant in Mesopotamia. It is supposed to have sprung from a wild grass in Central Asia. Hundreds of years would be necessary to convert the wild wheat into the prolific grain of to-day, for the original plant was small, bearded and misshapen.

From time to time claims have been made that the wild wheat that was the forerunner of our modern plant has been re-discovered. One botanist and explorer stated that he had found it in the mountains in Eastern Kurdistan, while it has been reported twice in Mount Hermon in Palestine, first in 1855 and again in 1906.

The earliest definite record of the cultivation of the plant was found in excavations made in 1926 at the ancient Sumerian site at Jemdet Nasr, 17 miles north-east of Kish. In a Sumerian house the excavators found, stored in a fine red-and-black jar, a quantity of charred wheat, which is almost certainly the only cereal ever recovered from the early remains of Mesopotamian civilization. The discovery shows conclusively that wheat was one of the earliest cereals grown by man, for the pottery and pictorial tablets also found show that the date at which the house was built was about 3500 B.C. This wheat proved on examination to be *Triticum turgidum*, usually known as Rivet or Cone Wheat. The seeds are small, dark red, with blunt ends, and have a dorsal hump characteristic of this species, which is the most prolific of all the numerous kinds of wheat. Thus the statements of ancient historians concerning the astonishing productivity of Babylonian wheat are confirmed.



British mortar of Roman times

Wheat of the type found in Sumeria is very little grown in Great Britain or in North America. What is known as "mummy" wheat belongs to this class. It is often said that grains of wheat recovered from the mummy cases of Egyptian interments have yielded a rich crop of corn when planted, in spite of the lapse of some four thousand years. This is a totally improbable story, unsupported by any reliable evidence and contrary to all experimental results. If any wheat grains alleged to be from such a source have germinated, it is possible that wily natives have slipped in grains from a supply of fresh corn at hand in order to impose upon the unsuspecting tourist. Actually the grain only retains its fertility for some 15 years at the most, but in spite of this fact the story of the vitality of "mummy" wheat is revived at intervals.

Wheat is a grass, and belongs to the class of plants known as monocotyledons. This simply means that the young plant starts its career with one seed-leaf or cotyledon only, while a pea, a typical representative of the dicotyledons, starts with two. Everybody is familiar with the appearance of the cultivated plant, but it possesses some very interesting features that may be easily overlooked and therefore are not generally known.

The straw of the wheat plant is beautifully built up in order that it may support the ears, withstand the rough winds and rain, and obtain and convey the nutriment from the soil and air to build up the golden grain. Split open a straw and note how the separate tubes of which it is composed are connected by a knot or joint, while for strength each tube makes an apex in the lower straw into which the upper one is tongued. Remark also the shining material that lines the inside of the ripening straw. This is silica (flint) deposited there in liquid form to strengthen the tube. It is indeed marvellous how a delicate plant, by means of acid liquid aided by gases and water, can form this solution from the constituents of the soil and produce such a beautiful result. While the root fibres have been employed in this manner, the leaves or flags, by absorption and transpiration, have done their part towards building up the ears of wheat.

In addition to the wonderful manner in which the tubular stems that support the ears of corn become lined with silica or flint to give them strength, each knot or joint in the straw or stem is endowed with a special gift or duty. These hardened nodes fulfil a most useful and wonderful purpose. When the straw is beaten down by rain, hail, or stormy winds, the tissue of the underside of the joint takes on a renewed growth, causing the straw to rise erect from that point, and so raise the loaded ear of corn that it may regain its position in the sun.

The flower of the wheat plant also claims notice, as it is the forerunner of the seed that furnishes us with our daily bread. When examined through a microscope it is seen to be a most beautiful object. The delicate silver-feathered stigma, surrounded by the three stamens with their golden-tinted anthers, are encased in two bracts or glumes that enclose the entire floret. They appear in June and the life of the plant as a food manufacturer has then reached a climax. It has reached its full size and most of its food-forming capacity is now devoted to the building up of the seed.

One of the most remarkable features of the plant is its enormous root system. Scores of roots spring from its base and penetrate deeply into the soil, the total length of roots of a single plant running to hundreds of yards. A large amount of food thus may be stored in them, to be drawn upon afterwards for maturing the grain.

The wheat plant is adapted to nearly every climate, from the frigid to the torrid zone; wherever man can live comfortably corn can grow. Without the assistance of man no wheat would grow,

however, for it is not a natural crop, but demands cultivation. If left to sow itself, every single plant would vanish in three years. The time to sow the seed has therefore to be so chosen that when the organs of the flower attain maturity there may be sunlight and warmth sufficient for self-fertilisation, a process which a ray of sunshine and a gentle breeze will then accomplish instantly.

Since the discovery of the laws of heredity in plants and animals, a scientific study of varieties of wheat has resulted in the production of new kinds that give larger yields and are less disturbed by weather variations and the attacks of natural enemies of the plant. The wheat grown to-day is thus immeasurably superior to that of a hundred years ago.

Briefly it may be said that the process consists in crossing those varieties of wheat that have specially valuable features, such as heavy yields, tough straw, etc., in order to attempt to produce varieties that combine them. Naturally it takes time to give these new varieties a thorough test, but the continuous efforts of scientists on these lines have resulted in some truly remarkable wheats.

Canada has figured largely in these experiments, and this great country is now the granary of the world. Last year's wheat crop amounted to 440 million bushels, of which no fewer than 315 million bushels remained for export after deducting corn required for seed and for home consumption. For a long time several very good varieties known as "*Prelude*" and "*Marquis*" have been the standard varieties grown on the prairies, but as the population of Canada has increased land further north has come into cultivation and new problems have confronted the wheat-grower.

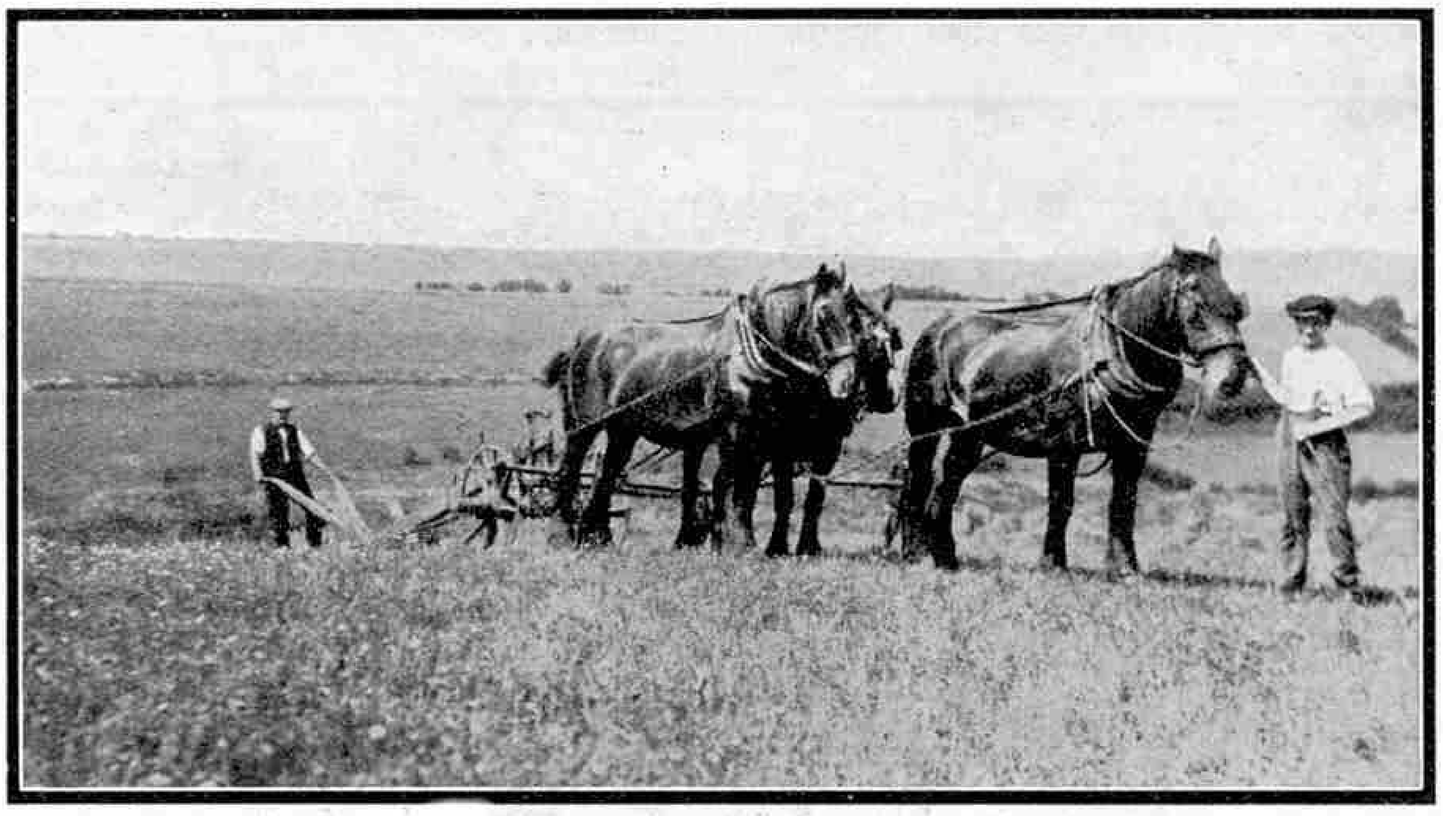
The chief problem was, of course, the shorter growing season. In the Peace River district of Alberta and in northern Saskatchewan the frosts come earlier than in the older parts of the wheat belt, and it was necessary to find a wheat that would ripen earlier than the standard varieties. The great discovery in this connection is the now famous "*Garnet.*" This is as prolific as "*Marquis,*" and gives a slightly better yield of flour, while it ripens 10 days earlier. Thus it is well adapted to the shorter growing season, and it has proved very successful in the northern districts of Canada.

Unfortunately "*Garnet*" has not solved the problem of "rust." Wheat is liable to the attack of a fungus that grows in red patches on the leaves and stems. The presence of this parasite lowers the vitality of the plant, and great loss is caused in districts where epidemics of rust occur.

Even this enemy will probably be overcome in some way or other, and in the meantime biologists are still at work trying to breed new varieties of wheat to mature in an even shorter time than is required by "*Garnet,*" and to possess many other desirable characteristics. As already noted in the "*M.M.*," a novelty in the shape of a wheat with a double sheath of bracts is promised—an extra protection of the seed from the effects of early frosts in late summer and early autumn that will make cultivation possible still further north.

Possibly the roast grains were used for food in the earliest days, but the advantages to be gained by grinding the corn were discovered far back in prehistoric days. In his own whimsical fashion Charles Lamb has related how a Chinaman discovered the superiority of roast pork over raw pig as a food, by the accidental burning of his house with a litter of pigs inside it. Remarkable numbers of houses were subsequently burned down in China until some genius discovered that a fire of any kind would serve the purpose just as well! We do not know whether any similar proceeding led to the discovery of the advantages of grinding and baking corn.

The Greeks ascribed the knowledge to the favour of the gods. According to their mythology, Ceres, the goddess of corn and harvest, was supposed to have instructed Triptolemus how to plough the land, sow and reap corn, make bread and cultivate fruit. The goddess is usually represented with a garland of ears of corn on her head, holding in one hand a lighted torch, and in the other a poppy, which was sacred to her. The association of poppies with corn is not good agricultural practice nowadays, whatever it may have been in the days when the worship of Ceres flourished!



The Old Wooden Plough

Man is an inventive and experimenting animal, however, and very early he became familiar with crude milling methods. The result has been the evolution of a remarkably complex and efficient system of making fine meal or flour from corn. Progress in earlier days was very slow. Until about 2,000 years ago all milling was done by simply pounding with stones. Then came the introduction of stones that ground the corn instead of merely pounding it. Subsequently power was applied, this being derived first from criminal or slave labour and later from waterfalls and the wind. About 170 years ago saw the beginning of the use of steam power, while much present-day milling is carried out with the aid of electrically-driven machinery.

Further refinements have been introduced at each stage of development. Nowadays the entire grain is not ground into flour, the crushing and grinding machinery being carefully adjusted so that its constituent parts are separated. Originally the only distinction made was between the husk and the interior of the grain, but to-day these two main products are carefully graded, and in flour-making various kinds of wheat are blended to give a satisfactory product. English wheat is sought after for flavour and Canadian wheat because of its hardness and "strength," or capacity for taking up water.

Before the miller plays his part the ripe grain must be cut and gathered, after which the grain must be extracted from the protecting sheaths, the operation usually described as threshing.

Each of these operations has undergone many improvements within recent years, and the old methods present the same contrast to those now used as ploughing with oxen does to the work of the powerful petrol or steam ploughs that turn up their long straight furrows in a fraction of the time required by the old-fashioned method. Nowadays farmers very seldom sow broadcast, scattering the seed by hand while crossing and recrossing the newly prepared land, and similarly we seldom see the scythe and sickle used for reaping. Sowing, reaping, binding and stacking are all performed by ingeniously designed machines. Even gleaning, from which country folk of past generations gathered a considerable harvest for themselves, has been rendered impossible by the use of efficient rakes.

When the sheaves of corn have been stacked and have dried sufficiently, threshing follows. In the East, corn was trampled out by oxen thousands of years ago and the grain separated from the chaff by throwing it up against the wind, which blew the lighter particles away. Oxen are still used for this operation in some parts of the world. The flail, the instrument that was used for beating out corn for many centuries, also came into use very early, as it appears as an emblem on the sarcophagi of buried Pharaohs. It remained the chief instrument for separating grain until comparatively recently. Made in two parts that were connected by a leather strap, it required dexterous hands to wield it and those unaccustomed to the task found it remarkably easy to hit themselves on the head with the unwieldy tool. The steam-threshing machine has practically banished not only the flail but also the winnowing machine that separated the grain from the chaff.

The threshing process leaves the corn ready for the miller, and the history of the methods adopted for turning it into flour are of very great interest indeed. It is probable that the primitive corn-crushing stones that have come to us out of the dim and distant prehistoric past—specimens of which have been found buried in the soil on the site of ancient lake dwellings of Switzerland, for example—were first used for converting acorns into a coarse meal. Their later development will form the subject of our next article.

Telegraph Line that Carries Nineteen Messages

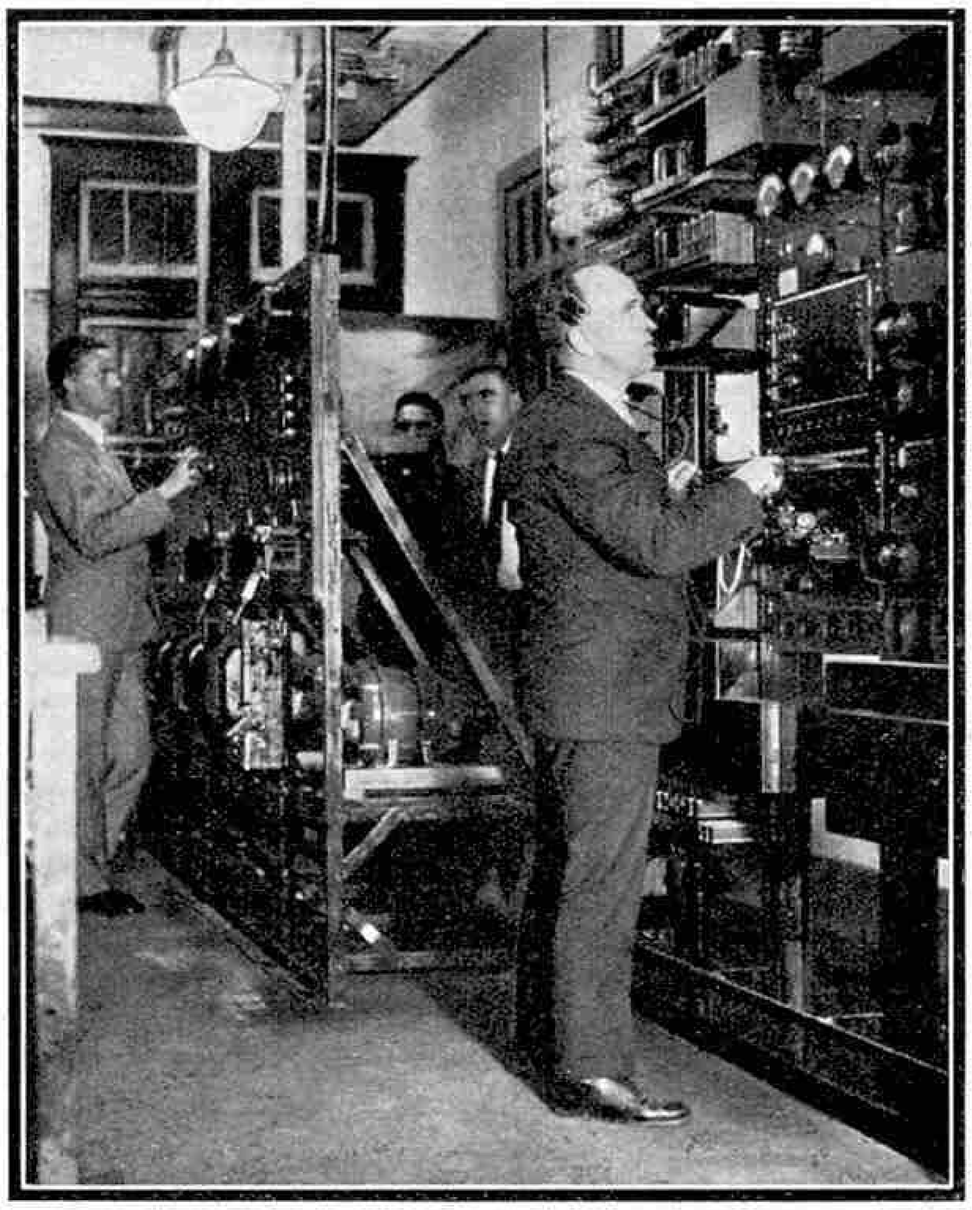
New System that Continues to Work when the Wire is Broken

A PRIVATE telephone that is unaffected by floods, storms, or magnetic disturbances such as accompany displays of the aurora borealis, has been installed between the head office of the Canadian National Railways at Montreal and the Western Divisional Headquarters at Winnipeg, over 1,300 miles away. It forms part of a "carrier current" telegraph system opened last year by the Canadian National Telegraphs between these two cities.

The new telephone operates over a longer distance than any other non-public installation in Canada. By means of it the various officials of the company are enabled to converse directly across half a continent without being subjected to the inconvenience of passing the call through a number of private exchanges and intermediate relaying stations. Before its installation calls from the Head Office of the Canadian National Railways to the Winnipeg office had to pass through Chicago and St. Paul, which was not only inconvenient but resulted in frequent delays. All trouble of this nature is now abolished.

The most remarkable feature of the new system is that the telephone messages are transmitted over the wires used for sending telegraph messages in Morse code. This is made possible by the introduction of the "carrier current" system, whereby 18 telegraph messages, in addition to the telephone message, can be sent over the same wire at the same time. This system of telegraphy is being introduced to Canada by the Canadian National Telegraphs in order to overcome the technical difficulties to which telegraph lines of the ordinary type are subjected in a country of such vast distances.

The "carrier current" telegraph system is based upon the same principles as wireless telegraphy, the message and signals being transmitted through the ether by means of electro-magnetic waves of various wavelengths. In the new system each message is sent in the form of waves of specific length, and the only difference between radio broadcasting and the "carrier current" telegraph system is that in the former the electric waves travel through the ether in all directions, while in the latter they are directed along a wire. The apparatus used at the receiving end includes tuning devices of the usual type to enable the operators to pick up any one of the 19 messages carried by the wire. Seven repeater stations are used in covering the whole distance of 1,300 miles.



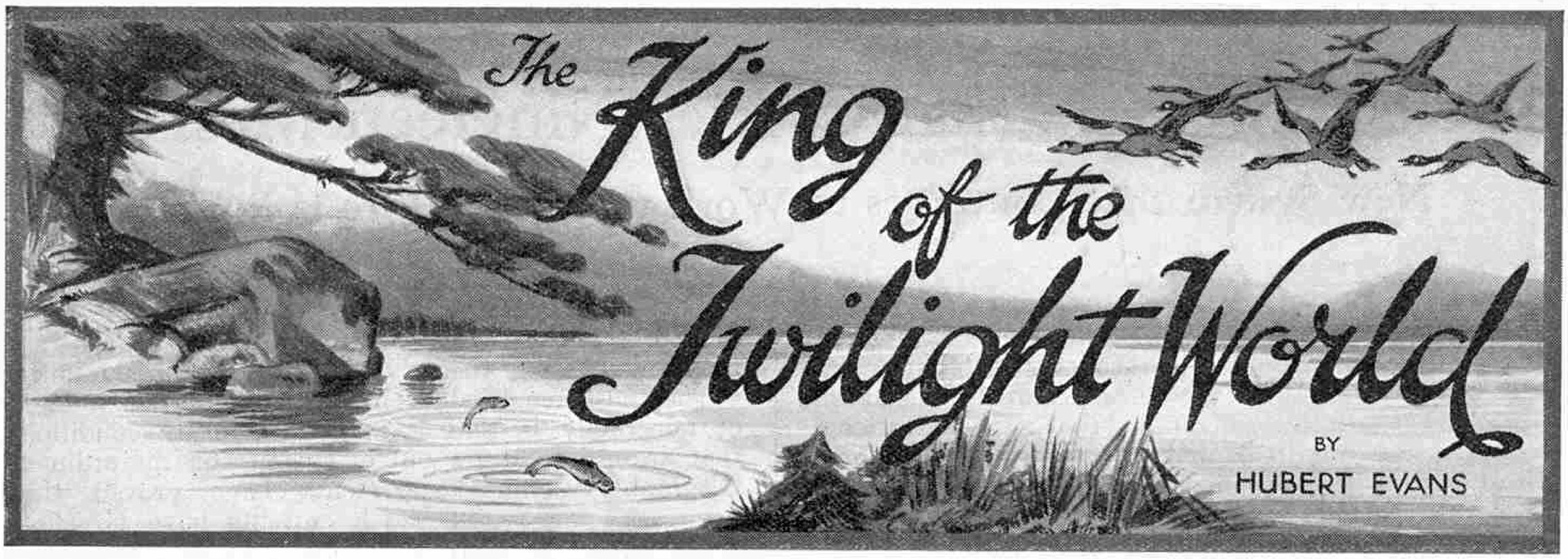
A typical repeater station, which is part of the mechanical equipment operating the new "carrier current" telegraph and telephone system

The most remarkable characteristic of this method of telegraphy is that it is unaffected by conditions that are apt to throw out of commission the ordinary telegraph system. Experiments have proved that earth currents have no effect whatever, and that poles and wires may even be completely submerged in water without affecting the transmission of messages in any way. It is particularly gratifying to find that earth currents have no effect. In ordinary telegraph wires these pass from the earth connection at one end to that at the other and are particularly strong during displays of the aurora.

Attempts were made to interrupt transmission by reproducing deliberately conditions that might arise accidentally. The most interesting of the experiments made for this purpose consisted in breaking one of the wires, and it was then found still possible to use the line successfully. Apparently the only effect of the breaking was to introduce an additional capacity, which did not prevent the transmission of signals any more than the introduction of a small condenser in an aerial wire prevents the reception of broadcasting signals.

This new departure in telegraphy marks a distinct advance in the accurate and rapid transmission of telegraphic messages, being economical both in regard to time and material. When first introduced it was only found possible to send 10 messages over the one wire, and this was regarded as the practical limit. As a result of experience, however, the number has now been almost doubled, while the telephone system has also been impressed on it.

The method by which telegraphic messages are actually sent is worthy of notice. Carrier waves of the desired frequency are produced in the usual way by a tuned oscillating circuit using valves—or vacuum tubes, as they are usually termed in America—and the contacts of a telegraphic relay are connected to the circuit in such a manner that the carrier wave is interrupted when the contacts are closed, and is suppressed for the duration of the signal. This is exactly similar to one of the methods commonly used in ordinary wireless telegraphy.



FOR days Angus had been trying to work his way upward through the clean gravel of the river bottom. Instinct told him that above was brightness and a vivid, moving world he had never seen and he did so want to reach it. But the way out was difficult to find. He would discover a little tunnel between the rounded stones and would scurry along it in the dark bumping his nose and scraping his fins at its sharp turns, all unmindful of the discomfort of these collisions in his lusty desire for liberty and adventure in the unknown world of the river. But always the tunnels ended abruptly and he must stop before the barrier, his gill covers heaving, and his tiny pectoral fins throbbing from the furious exertion. But he must not rest for long. The tug of the unseen sunlight urged him to renew his fight against these stupid stones that vainly thought they could imprison him down there in the dark.

Romance lives in the air, on the earth and in the twilight world of the streams, rivers and the ocean. From the eagle, sailing so high amid the skies that even the sharpest eyes fail to see his form, to the deep sea fishes in the ocean depths, man has studied them all, analysed them and, in part, has reconstructed the story of their lives. In "*Angus, the King of the Twilight World*," Mr. Evans acted as biographer of the cut-throat trout, a famous game fish of the Rocky Mountains. An authority on the subject, Mr. Evans is well-known on the Pacific Coast as a fishery expert and his life of this interesting denizen of British Columbia waters forms a story that is an outstanding contribution to the piscatorial literature of the day.

Six weeks ago a pair of cut-throat trout—his parents—had hollowed a nest in the gravel and spawned in it; and after they had finished, the little stones had filled in the hole and hidden the eggs from the prying eyes of rapacious merganzer ducks, or the occasional water ousel with an unnatural fancy for fish eggs. More than one sluggish sucker and Rocky Mountain whitefish had moved over the stones, ignorant of the tasty feast they hid.

Yes, the stones had hidden him then but their usefulness was ended and he wanted to get out. He would get out, he knew, if only he kept trying. The sunlight was calling him and he must get up there above the darkness and the stones.

His escape was absurdly simple. He found another tunnel, followed it as he had the others. It turned sharply upwards. He spread his tail as wide as it would stretch and put all his little strength into one sharp, swirling thrust and immediately he found himself under the edge of a small flat stone with the welcoming river flowing clear about him.

He did not leave the cover of the flat stone at once. Here was a new world waiting for him but the bright light dazed him and the dancing shadows on the bottom were not reassuring. He kept to his cover while his disproportionately large eyes grew accustomed to the glare and his sensitive sides learned the feel of flowing water.

He was not hungry. The yolk sac, which had been attached to his underside when he kicked himself free of his weakened shell, had fed him. Now it was almost absorbed, a mere red streak against the barred silver of his flanks, but the compelling call of hunger had not come strongly to him.

In the late afternoon when the May sun had gone and the mountains upstream beyond the lake changed from white to glowing pink, there were no more dancing, disconcerting shadows on the river bed. Dusk seeped from the sombre cedars and giant spruces that wall the river, and felt its way across riffles and foam-flecked pools. Angus darted clear of his flat rock to go exploring.

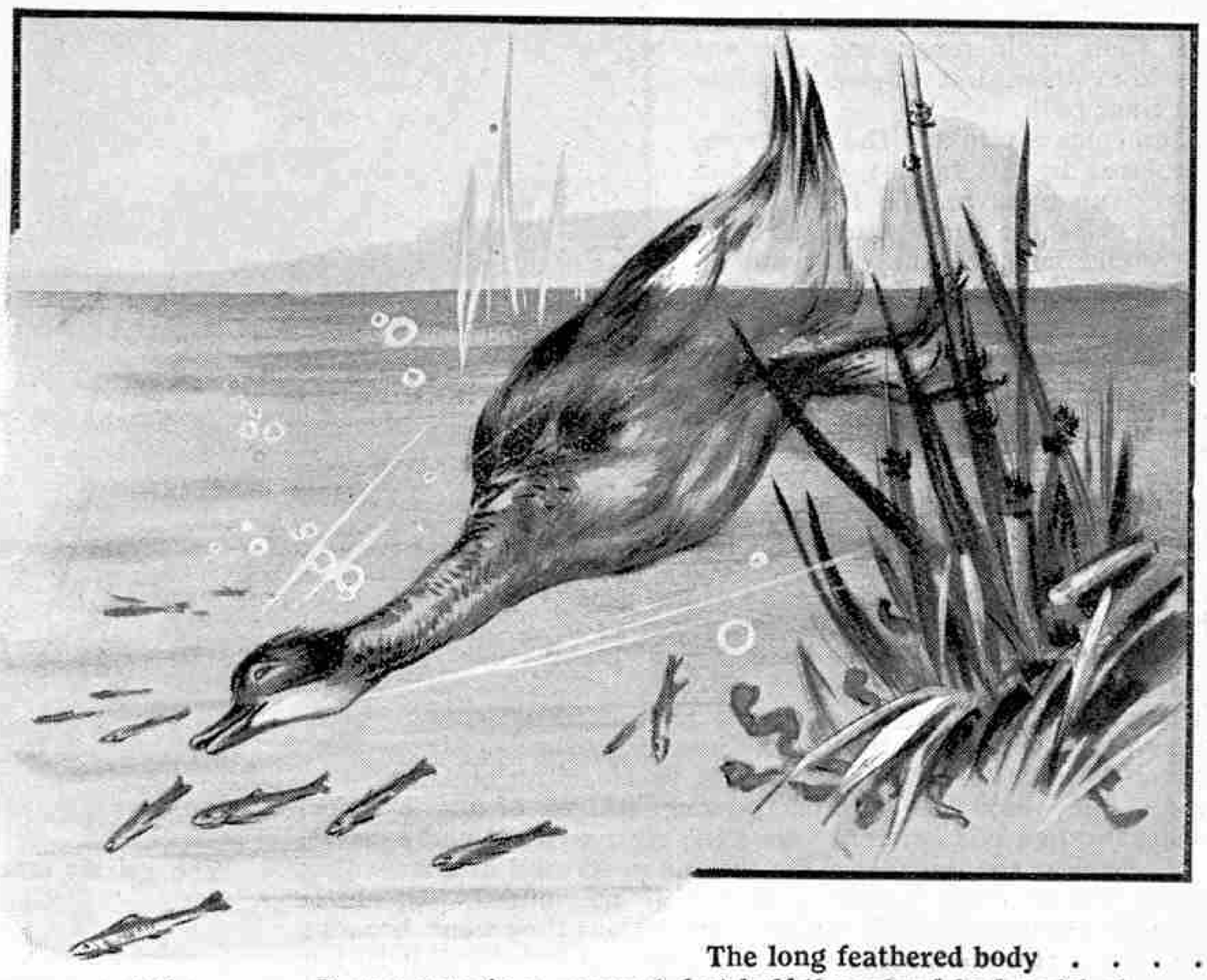
The water was shallow and gently flowing where he was, its surface dimpling against the cold spring sky. But from out in midstream came the heavy throb of strong hurrying waters. He could feel it along his flanks. He could not swim properly yet; he could not remain suspended in the water but must dart, then come to rest on the bottom, his pectoral and ventral fins well braced to steady him, his tail curved ready to dart again.

But it was glorious sport. He saw a score of his brothers and sisters who had come from the nest through other tunnels and, like himself, were making their first tentative exploration. He darted out to join them, curving and turning sharply in flight, proud of his superior skill. They were smaller than he, some not an inch long, while he was almost an inch and a quarter. He shot to the head of the school in a vainglorious gesture of challenge.

Had the sun been shining or if even the light had not failed so, they might have seen the merganser duck coming, but it swooped with such vicious swiftness among them they had no time to hide. The long feathered body with the powerful webbed feet astern, drove among them, the sinuous neck shot to left and right and down. It was gone in a moment but half the school had perished. Angus lay all night where he had wedged himself between the stones.

The days that followed were filled with experiences and discoveries. Perils and delights crowded them. Angus learned to swim. The remnants of the yolk sac disappeared, his digestive organs were modified and enlarged, and the air bladder against his ribs grew and made him buoyant. He learned to use his fins so that he rose or sank through the water. To learn this—even before he had gained full control of the fins needed to change his horizontal position—was not simple, and more than once he collided head-on before he mastered the art. But such trifles did not dampen his enthusiasm. He thought his feats marvellous.

The little cut-throat were all feeding now. They ranged themselves where the water flowed briskly between two boulders, all headed to the current with fins working vigorously. Sometimes one of the less skilled would be caught broadside on by the water and carried to the tail of the line before he could recover control. But as the days passed these errors were less common.



The long feathered body . . . . drove among them . . . It was gone in a moment, but half the school had perished . . .

They darted at every particle the river carried to them, but soon they learned to distinguish shreds of wood fibre and such inedible stuff from the minute crustaceans and larvae. When they had gorged they angled out of the current to the slack water behind the boulders and rested there with gently moving fins. But always they watched for enemies. A swift-moving shadow from above, a vague moving form of a fish coming from the deeper water to forage in the shallows, and they scattered to dart for cover among the stones.

Sometimes when the shadows of the great trees were long across the river they moved close inshore under the sweeping cedar boughs and fed on dancing midges, gnats or newly-hatched mosquitoes. It was glorious sport, that; springing clear of the water after the moving flies, then falling with a ludicrous flop. Sometimes they jumped at flies far beyond their reach just to experience the reckless exhilaration of the leap.

Sometimes, too, curiosity took them toward midstream where the water bounded down over the hard-packed gravel of the riffle. It was exciting to feel the surge and fall of the mad water, to be lifted and carried by it, to feel the deep vibration of it along their sides.

Various enemies had reduced the school to eight when one July afternoon Angus led them out. The shadows thrown by the swirling waters were greater, more erratic than the dimpling fluctuations of shade they knew in the shallows; the bottom was dropping off below them, faintly green with depth. But the madness of the bubbling, air-charged water intoxicated them and made them bold.

Below, unseen, a two-pound Dolly Varden lurked. His dark back and spotted sides made him seem part of the dim bottom but for him, against the sunlight, their silver bellies and beating fins stood out fatally clear. His white-edged fins moved cautiously. He rose slowly until he knew they must soon see him, then rushed the little explorers. The impetus took him to the surface where he churned the water to rush again. One cut-throat fingerling had been gulped down and like an angry flash he was after Angus who darted in a frantic zigzag for the shallows. But already the Dolly was upon him. He missed and turned to strike again. Angus went to the surface and as his enemy closed, leaped clear. It was a mightier leap than any he had made under the cedar boughs but the practise there served him in good stead now. Each time the Dolly rushed the tiny cut-throat jumped a foot or more above the water and landed two or more feet beyond. His jumps were erratic but they all took him nearer shore. The enraged Dolly churned the water behind him, always an instant too late. Panting, Angus reached the shallows where the Dolly could not follow.

None of the others rejoined him. Perhaps they had been devoured by the Dolly on his return from the shallows, or else had become confused and had taken to the swift water and been carried downstream. Angus never saw them again.

By August, Angus, because of his watchfulness and the unerring accuracy of his rushes at the larvae and other food the river brought him, had grown to be three inches long. His back was well rounded, the muscles of his sides firm and quick to act. The pair of kingfishers who nested in the cedar had once frightened him but now he was contemptuous of their splashing dives. They had seized several of his brothers and sisters and carried them to their untidy nest but after their attempts to take Angus they left the water, scolding horribly, and rose to a dead branch to await easier game.

August was a strange month on the river. From the north Pacific and into the Skeena great schools of salmon had made their way. They came from their unknown feeding grounds in the vast northern sea and with unerring instinct ascended the river whose tributaries had reared them three years before. At first Angus fled from them in terror; great fish with sharp teeth who circled the pools or jumped clear of the water in play and smote it so that the sound was heard even back in the dense woods beyond the banks. The salmon crowded the pool and at times in their restlessness invaded the shallows where he lived. He soon learned

they were no longer feeding and would not harm him. Thereafter he traded upon their indifference and did not dart from them but angled leisurely from their path.

Then came a rain and the river rose. Stimulated by the freshet, the salmon crowded upstream to the lake off the mouths of whose clear glacial streams they would lie until the call came to ascend them, spawn and die.

Following them came great schools of humpback salmon. They filled the pools and overflowed into the shallows. They were everywhere. All night in the moonlight they jumped and splashed. Angus found the commotion strangely exciting and moved up and down river restlessly. He found too, that when these salmon commenced to spawn the Dolly Vardens and some of the larger rainbow and cut-throat trout fed eagerly on their drifting eggs and, being gorged, paid little attention to him.

Throughout the North Country the routine of similar rivers was disrupted by the invading salmon. Into tributary streams from Prince Rupert to Hazelton and far beyond, they crowded, hurrying under bridges of the railway, fighting through box canyons where the river writhed and snarled, on and up past the weathered fur-trading posts and into spawning streams whose clean water purled and murmured. Up little streams to the very foot of un-named mountains they went, brought home by the strange homing call of nature. A weird call it is, felt by solitary men and all the children of forest and stream; a call that is ever new yet as old as time itself.

And on the river where Angus lived the response was as eager as it had ever been. In those vast cathedral valleys time is not measured by the man-imposed petty scale of hours and days, but by seasons and age-old migrations. Answering the call, to the river came great strange creatures.

One clear September evening the moon, like a colossal balloon of cold fire, disentangled itself from the jagged snowpeaks and floated clear. The centuries-old cedars cast grim shadows across the river, on whose moving surface they became distorted shivering monsters. Far up in the moonlight the lean air was a-quiver with the flighting song of a wide battalion of whistling swans. Bathed in the unreal light a wedge of Canada geese, fleeing southward from the Northern tundras, set the grim peaks echoing with their eerie questing cry.

Down on the river a dugout canoe hugged the black shadow of the shore. The Indian and the white man in it heard the calls from the sky and passed a stealthy comment. But neither took his eyes from the moon-bathed gravel bar ahead.

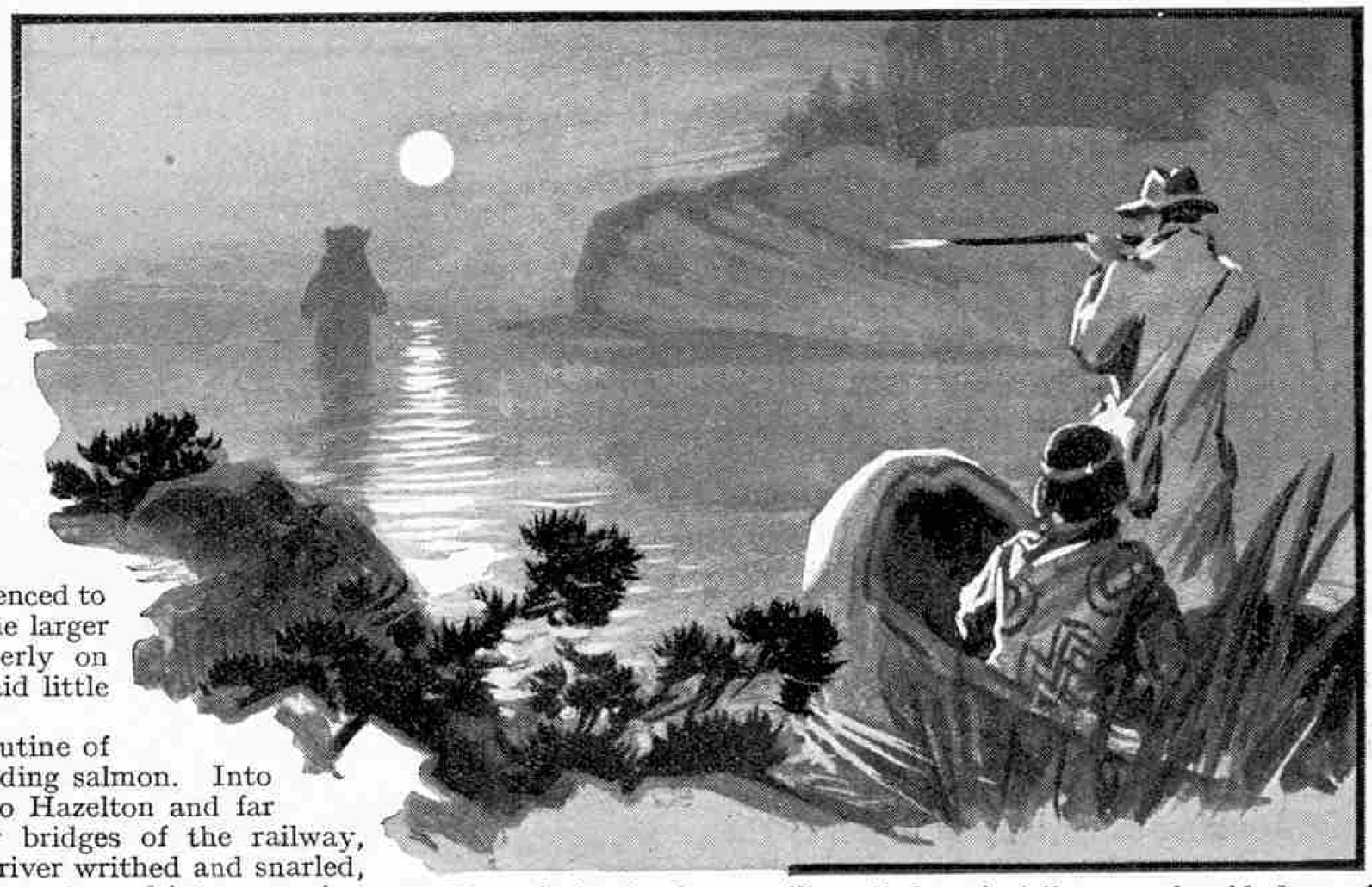
Salmon, with backs exposed, furrowed the shallow water about the bar like crazy ploughmen, twisting and circling tirelessly as they searched the loose gravel for spawning places. The moonlight glistened on their dripping sides. The sounds of their wallowing drifted back into the forest. The hunters waited.

A great grey shape crossed the black edge of shadow and advanced, with easy rolling gait, across the bar. It stopped, sniffed and went on to the water's edge. The wallowing of hundreds of salmon drowned the low click as the white man removed the safety catch of his rifle. Then the fish saw the grizzly and fought their way to deeper water. They lashed the shallows to vivid whiteness; the smothered roar of their escape drifted far down the river.

The grizzly slouched out to where the water came halfway to his shaggy belly and waited. There was menace in the hulking lift of his shoulders as he stood, silhouetted against the moon's wide lane of silver light. The hurrying water curled and eddied about his mighty legs, carrying on with it his strange strong body scent. Angus, who lay below the fall of the riffle, sensed it and darted excitedly through it, working upstream until he came to the edge of the great shadow of the bear. This alarmed him and he dropped back, interested but wary.

But the salmon, with the spawning urge strong upon them, could not for long remain off the shallows. Soon they were circling and splashing again, brushing the bear's legs, passing beneath his belly. He knew he could kill now at what instant he pleased, but still he waited amused by the certainty of victory and by their surpassing ignorance.

Fifty yards downstream in the black shadow a sombre rifle butt came slowly to a wool-clad shoulder. The Indian in the stern of the dugout braced his pole against the gunwale to offset the faint lift and fall of the backwash.



The grizzly stood . . . silhouetted against the moon's wide lane of silver light . . .

A rapier of hard fire stabbed the black shadow. A ripping crack smote the walls of timber. The grizzly leaped wildly and crashed, asprawl, on the water's edge. His maddened bellow dropped to a petulant long-drawn whimper. A bubble formed between his lolling tongue and jaw, expanded strangely with his last reluctant breath, then snapped. Echoes of the shot still came from the mountains beyond the lake, faint booming sounds that leap-frogged one another and finally dropped over the range to silence.

The dugout came swiftly upstream to the bar, its slender arching bow cleaving the water keenly, the two men poling. The canoe hung on the brink of the riffle while they examined the bear warily. The white man extended a dripping canoe pole and prodded him. "Dead," said the Indian and ran the dugout ashore.

Tugging mightily they rolled the great limp body on to the bar and the blood and water that dripped from it formed a tiny rivulet through the stones and sand to the river, then ran downstream in coiling red wisps into which eager little trout darted, their senses a-tingle with the fresh un-clotted blood.

After an hour's work with skinning knives the rumpled hide was dumped into the dugout and the hunters slipped away downstream. At dawn four baldheaded eagles were feasting on the carcass.

Week followed week and still the salmon came on. The first schools finished spawning and dropped downstream to die and others moved on to the shallows to scoop out their nests. They turned out many of the eggs of their predecessors and sent them whirling down river. Water fowl, Dolly Vardens, suckers and Rocky Mountain whitefish gorged upon them, and still enough remained to whiten large patches of the bottom in the slackwater at the edges of pools and behind rocks. These white eggs were dead for they had been disturbed at a delicate stage of incubation and the swift current had been fatal to the embryo.

In October the cohoe salmon came but most of these pushed on to the lake. Some spawned where the humpbacks had spawned and turned out more eggs for the river to carry away.

The river now was a river of the dead. Silence reigned in the place of the strange exciting days and nights of a month ago. All down the river to the Skeena and to the sea the stir caused by the salmons' migration had died. The gaunt white-washed canneries between Essington and Prince Rupert were boarded up, deserted by the jostling fleets of Northern fishermen. Some had gone to trap or to other occupations ashore; others waited for the halibut fishing out to sea. And inland along the many spawning streams, winter was reaching to set its great still hand.

Each day it lengthened the mantle of snow down the green flanks of the mountains; a coldly-beautiful robe that lay lightly upon the timber. Deer, caribou, mountain goats, and farther inland the moose, all felt that the regime of summer was ended and knew they must soon be subjects to a harsher rule. They sought lower feeding grounds. The philosophic bear shuffled sleepily to his den.

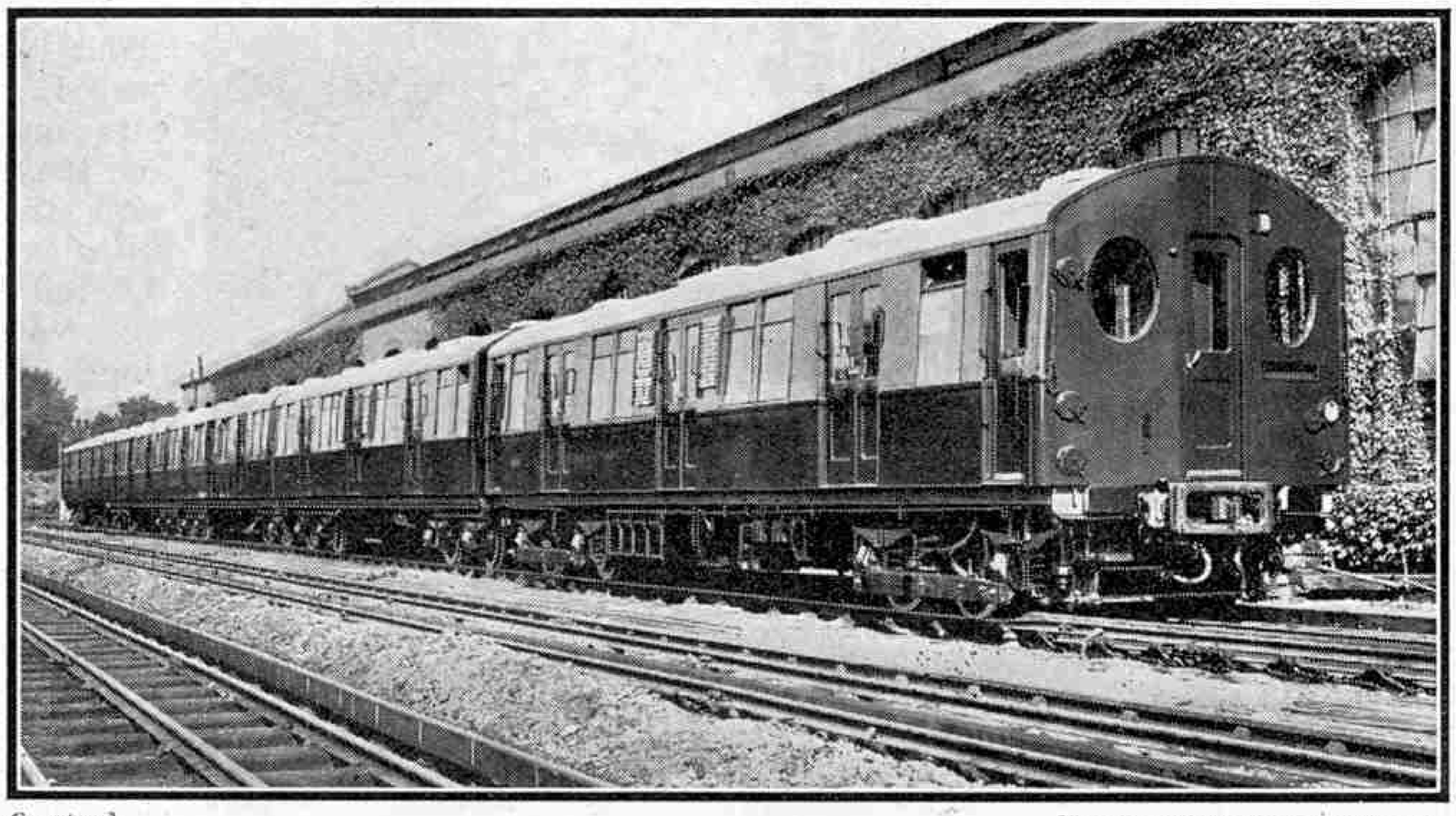
(Continued on page 555)

Driving an Electric Locomotive

A Trip with a Driver on the "District" Railway

By D. Arnold-Forster

TO judge by appearances only, the driving of an electric train is a much simpler affair than the driving of a steam locomotive. The electric train driver seems to have little more to do than to move two or three handles this way or that, and the results of these movements are seen only in a changed movement of the train, without the accompanying rush and roar of steam that makes the steam locomotive so attractive. Nevertheless the electric train is by no means a simple matter and the various operations involved have a special and peculiar interest of their own. The best method of realising this is to take a trip along with a driver, and we will suppose our driver to be in charge of a London Metropolitan District train running from Ealing Broadway terminus to Whitechapel.



Courtesy [*London Underground Railways*

A typical Metropolitan District Train

This section of the line takes us from the west to the east end of London and covers a distance of 12 miles with 26 stations. The first part of the run is out in the open and the subsequent underground portion of it passes through the double-tracked tunnels constructed for the old steam trains.

On one of the many lines at the big depot at Acton is standing a train of six maroon-coloured cars all ready for running. The train is made up of three motor cars and three trailer cars. The motor cars, each of which carries beneath it two electric iron-clad motors, are arranged one at each end of the train and one in the middle. Before "taking over," the driver and the guard visit the inspector's office and examine the certificate of the mechanical department stating that the train is fit for service. They then proceed to make a brief examination of the train and prepare it for its journey. The driver walks quickly around the train in order to see for himself that the electrical and air connections between each car are properly made. He also makes sure that the main motor switches alongside each motor are cut "in" and that their big fuses are in position.

One of the principal electrical connections between the cars is a flexible double-connecting piece for the main cable, which carries the current picked up by the collecting shoes on each motor car from the two live rails on the track. By keeping down the collecting shoes on each of the three motor cars a complete break of current is avoided when one of them passes over points, where there are always gaps in the live rail. There is also a flexible connecting piece for the control circuit that runs along the whole of the train and enables all the motors to be controlled simultaneously from any driving cab.

Next, there are two flexible hose connections for the Westinghouse brake system. One of these connects the main air reservoir beneath each motor car, thus allowing the air compressor in any one of them to be used. The other connection serves to join up the "train-line pipe" which controls the brakes from the driver's brake valve in any cab, and charges the auxiliary air reservoirs under each car. The air-cocks for these pipes between cars must be open right along the train and closed at each end.

Other important outside fittings to be examined are the "trip-cocks." These are actuated if the train accidentally passes a signal at "danger," and they then immediately release air from the train-line pipe, thus applying the brakes and at the same time cutting off the current from the motors. The tripping is carried out by a short movable arm that rises close to the rail abreast the signal. The driver must make sure that the trip-cock in front and on the right of the leading motor car is set so that it is ready to come into operation.

Passing round the train the driver jumps in and out of each cab, starting with the front one where he switches on the air compressor and its governor, which then will automatically pump all the main reservoirs up to about 75 lb. pressure. In each cab he sees that the master controller used for driving is locked in its "off" position and that the small reverse handle, without which it cannot be unlocked, is removed. In order to make certain that no master controller can be moved by anyone but himself the driver always

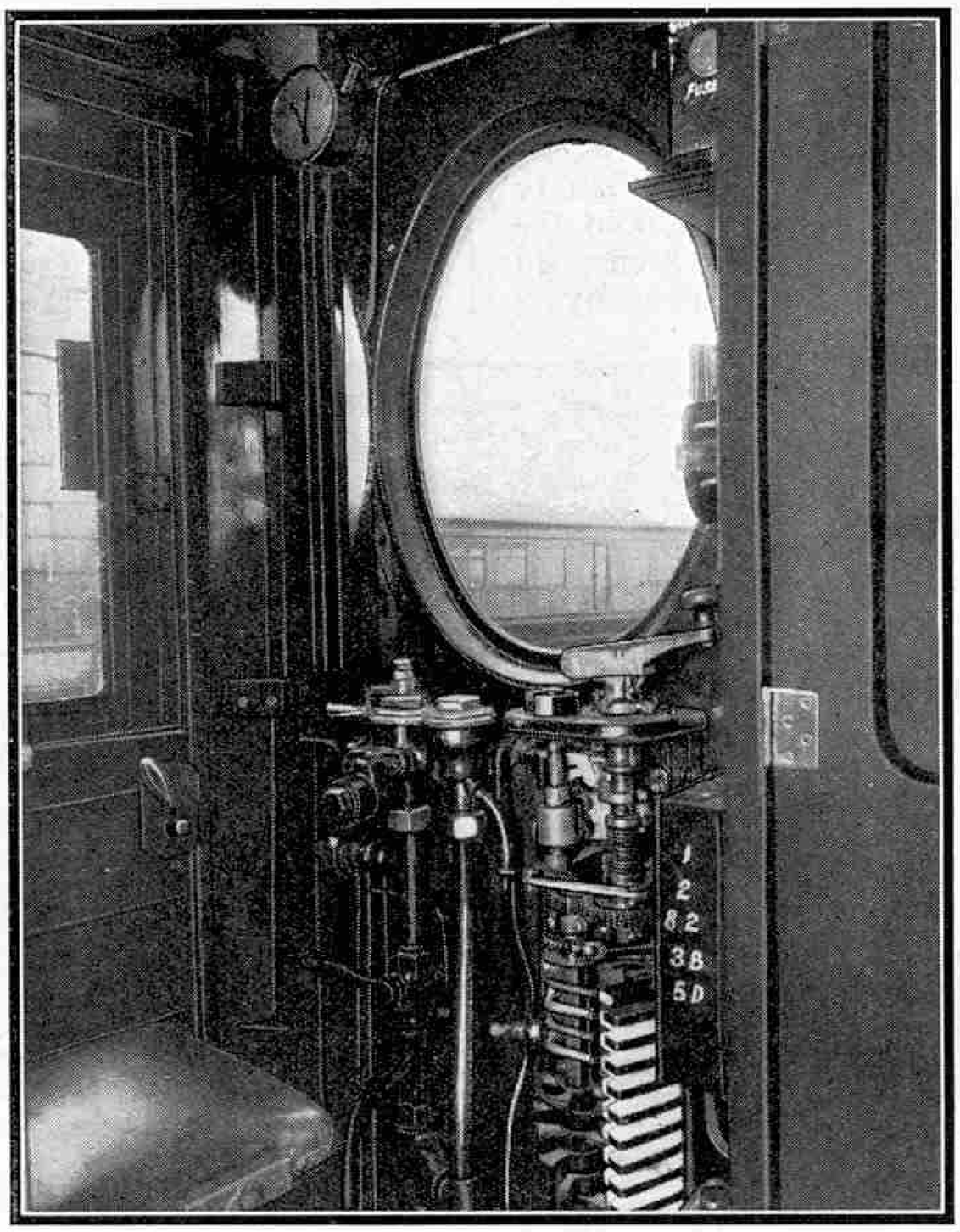
carries the reverse handle in his pocket and nobody else has one. He switches on the control circuit switch in his front cab and sees that it is off in the other cabs, and also makes sure that all driver's brake valves but his own are cut out by closing their isolating cocks. He also ascertains that all hand screw-down brakes are off—a matter that is easily overlooked. In addition, he switches on his proper distinctive headlights, and makes sure that all automatic circuit breakers are in by tripping and resetting them with his circuit breaker switch.

If all is correct so far, the driver is now ready to test the brakes. He gives two blasts on the whistle and the guard makes a full "emergency" application of the brakes by opening the guard's valves in the rear of the train. Having satisfied himself that all brakes are on, he signals to the driver, who takes them off by working his brake valve, the guard listening meanwhile to hear all brakes along the train release. Afterwards the driver makes an ordinary application of the brakes from his cab, releases them and moves his train a few yards to make sure that all brake blocks are off and that the main current is on to the motors.

Under the direction of the shunter the driver now pulls the train slowly out of the network of sidings on to the main line and takes it empty up the hill to Ealing Broadway. Before passing the "home" signal outside the terminus the brakes are tested and speed is reduced so that, in the event of the air brakes failing to act, the train could be stopped just short of the buffers by means of the hand brakes.

The driver now has to change ends. After making a full "emergency" application of the brakes he cuts out the driver's brake valve by closing its isolation cock; switches off the control circuit and headlights; removes the reverse handle from the master controller and puts it in his pocket; picks up his bag of tools and goes to the other end cab. There he immediately cuts in the driver's brake valve and releases the brakes; switches on his control circuit and headlights; puts on the small reverse handle and waits for the starting signal to drop.

The clear open run to Hammersmith provides a good opportunity of watching the method of driving. Immediately the starting signal drops, the driver blows the whistle by pressing a foot pedal, and as soon as the passengers are clear of the doors of the train the guard waves his green flag. The driver now takes hold of the controller and presses down with the palm of his right hand the safety button on the top of the handle. He then unlocks the controller by moving forward the reverse handle. After this he must keep the safety button pressed down the whole time; if he lets it go the brakes are applied with full force and the current is cut off from the motors—exactly the same effect as results from being "tripped" by the trip-cocks. The object of this is, of course, to stop the train quickly if from any cause the driver should become disabled and let go the controller handle.



Courtesy [*London Underground Railways*

The motorman's cabin, showing the driving mechanism

Without loss of time the controller is moved to the first notch, which switches on each pair of motors in series but through a large resistance. The train begins to move and the controller is then moved step by step to the fifth notch, pausing about two seconds on each one. Each of these notches cuts out more resistance and the fifth cuts it all out, with the motors still in series and giving about half the full speed. The controller may be kept for any length of time on this fifth notch but if it is kept too long on any of the first four the resistance will heat up.

The controller is kept on the fifth notch while the train draws out and passes over the points and cross-overs of the terminus. Then, if the signals ahead are clear, it is moved gradually notch by notch up to the ninth. The sixth notch puts each pair of motors in parallel, through resistance, and at the ninth, the full speed notch, the motors are in parallel with all resistance cut out.

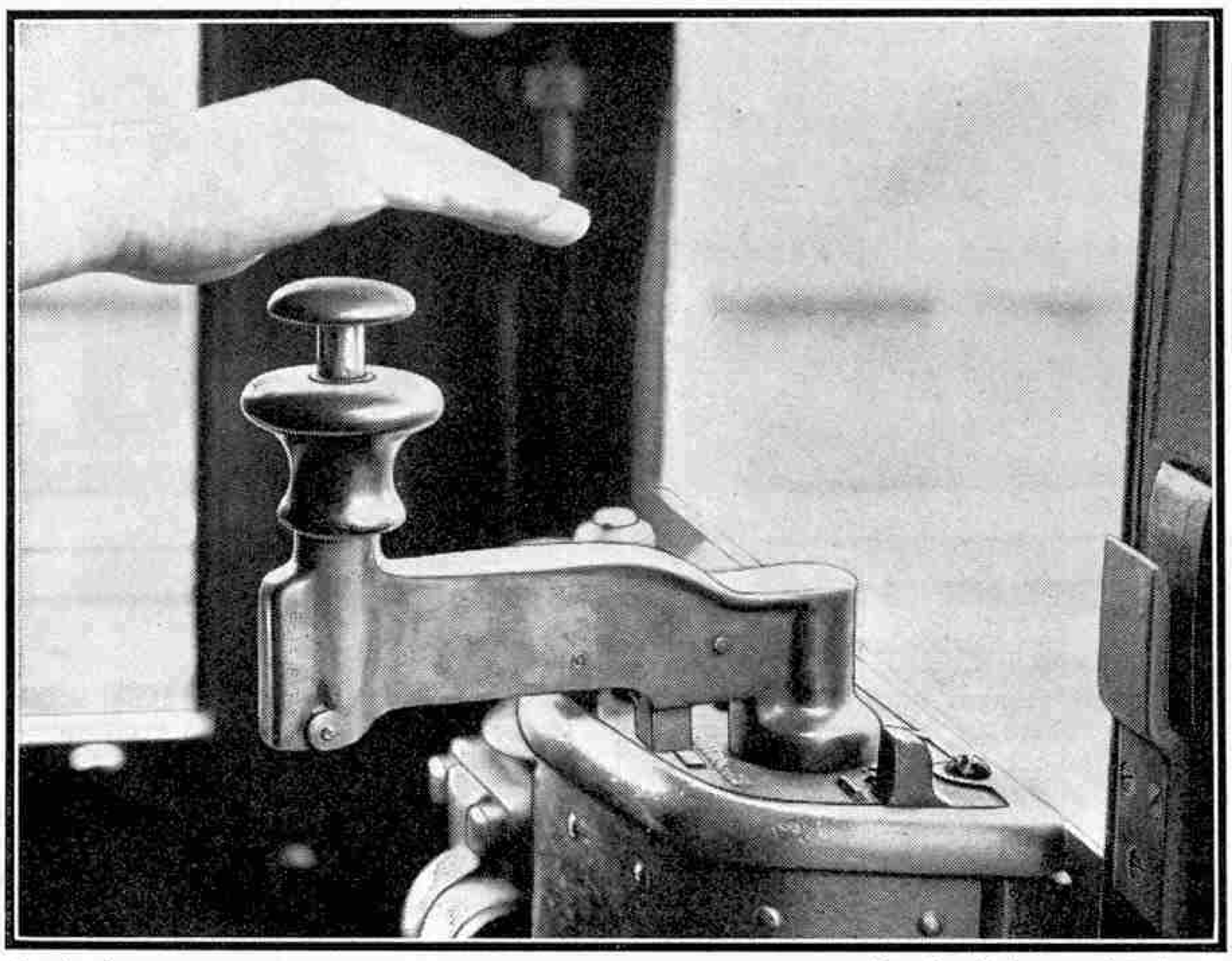
With the train "light" as it is at present, and on a level road, the controller can be notched up fairly quickly. Later, as the train fills up with passengers, or when starting anywhere on an incline, a longer pause is made on each notch. The driver's aim is always to get up speed as quickly as he can without any jerking and straining of the motors as he passes from one notch to another.

Just as the train begins to attain a good speed the line ahead is seen to curve sharply to the right over some bridges, and speed must be reduced. In order to do this the controller is moved smartly back to the "off" position and the train is allowed to run by its own momentum. In this manner, without any application of the brakes, the train is slowed down to a safe speed by the time the curve is reached. When the curve is passed the controller is notched up quickly to correspond with the speed of the train and then gradually notched up again to full speed.

After a mile run current is shut off for Ealing Common. In good time the driver gets the train in hand by moving his brake-valve to the service position to make a moderate

application of the brakes, and holds it by moving his valve forward to the "lap" position. The train runs on into the station with brakes held on steadily and then at the proper moment, depending upon the speed and weight of the train and the gradient, the driver makes a stronger application and holds it again. Just before the train comes to rest he moves his valve right forward to the release position so as to ease the brakes and avoid a jar on stopping.

As the front cab pulls up opposite the proper place on the platform for a six-car train, the air compressor is heard to start up. What happens is this. The service position of the brake-valve lets air escape from the train-line pipe and the reduction of pressure causes the triple valves under the cars right along the train to move so as to admit air pressure from the auxiliary reservoirs into the brake cylinders. The lap position closes all air passages and holds the pressure in the brake cylinders; the release position lets air from the main cylinders into the train-pipe. This air pressure reverses the triple valves, which then admit air to the auxiliary reservoirs to recharge them. The triple valves at the same time also release the pressure in the brake cylinders into the atmosphere, thus taking off the brakes. When pressure drops in the main reservoirs as the result of charging the auxiliary reservoirs, the air compressor starts automatically and pumps them up again.



Courtesy] [*London Underground Railways*

A close-up view of the "Deadman's Handle"

To make a clean non-jarring platform stop like this with only two "held" service applications is the ideal. Usually more than one additional application is found necessary, but a good driver will seldom have to "release" before the final stop and will avoid skidding, a practice that produces flats on the wheels. It is all a matter of judgment and experience.

As soon as the train-pipe has had time to recharge all auxiliary reservoirs the brake valve is put back into the running position. This is the normal position for running, and it allows a small make-up feed of air to pass into the train-pipe so as to ensure that the pressure does not drop in the auxiliary cylinders. There is still one more position—with the brake valve right back—called the "emergency" position. This makes a sudden full application of the brakes and it is rarely used by an experienced driver except for testing the system at rest.

The guard now waves his flag and the driver blows his whistle and starts up as before. There is a short quick run down into Acton Town and several strong service applications of the brake are made to bring up the train at the platform. Then follows a clear run, with slight gradients up and down, past Chiswick Park, Turnham Green and Stamford Brook to Ravenscourt Park. On this stretch a good speed is attained with plenty of "coasting"—that is running with the controller and brakes off.

Coasting saves current and drivers are encouraged to do it as much as they reasonably can without losing time. They are expected also to make as few unnecessary stops as possible between stations, because each starting-up again means a great expenditure of electrical energy and consequently a greater fuel consumption at the big power station at Lot's Road. If a driver sees a signal against him some way ahead he cuts off the current at once and coasts up to it. In the event of its clearing before he reaches it, as it very probably will, he can speed up again without much waste of power. If, on the other hand, the signal remains against him, at his reduced speed he can bring the train up close to it with the brakes, in a short space.

Signals at junctions and other special places are operated by signalmen from their boxes in the ordinary manner, but most of the signals along the line are automatic. They are normally at the "off" or clear position, but are set at danger when a train passes them and remain so until it clears the section beyond. Every automatic signal is repeated by a "repeater" signal in the section farther back, so that drivers have plenty of warning of what to expect. The arms of semaphore repeater signals are painted yellow and they are treated as "danger" signals. In the dark tunnels semaphores are replaced entirely by coloured lights close to the ground, and showing green in the clear position. An actual signal shows red at danger and a repeater shows orange. Most of the signals are in vertical pairs, the lower one being the repeater of the next signal farther on.

Just after leaving Ravenscourt Park comes the top of a steep bank, the bottom of which consists of a short tunnel on a sharp curve running down into Hammersmith. Coasting carefully down this bank, the brakes are applied lightly and held on to keep the train well in hand as it enters the tunnel and grinds round the curve into the station.

Now comes a fairly straight easy bit through Baron's Court with the queer squat-looking Tube trains running close alongside. A short drop to West Kensington is followed by a curly bit crossing another line, many signals, two junctions, a tunnel, and a short pull up to

one of the long platforms at Earl's Court. Here in an office overhead is the Traffic Superintendent, who knows what every train on the line is doing and who quickly spots one that is delaying the punctual flow of traffic.

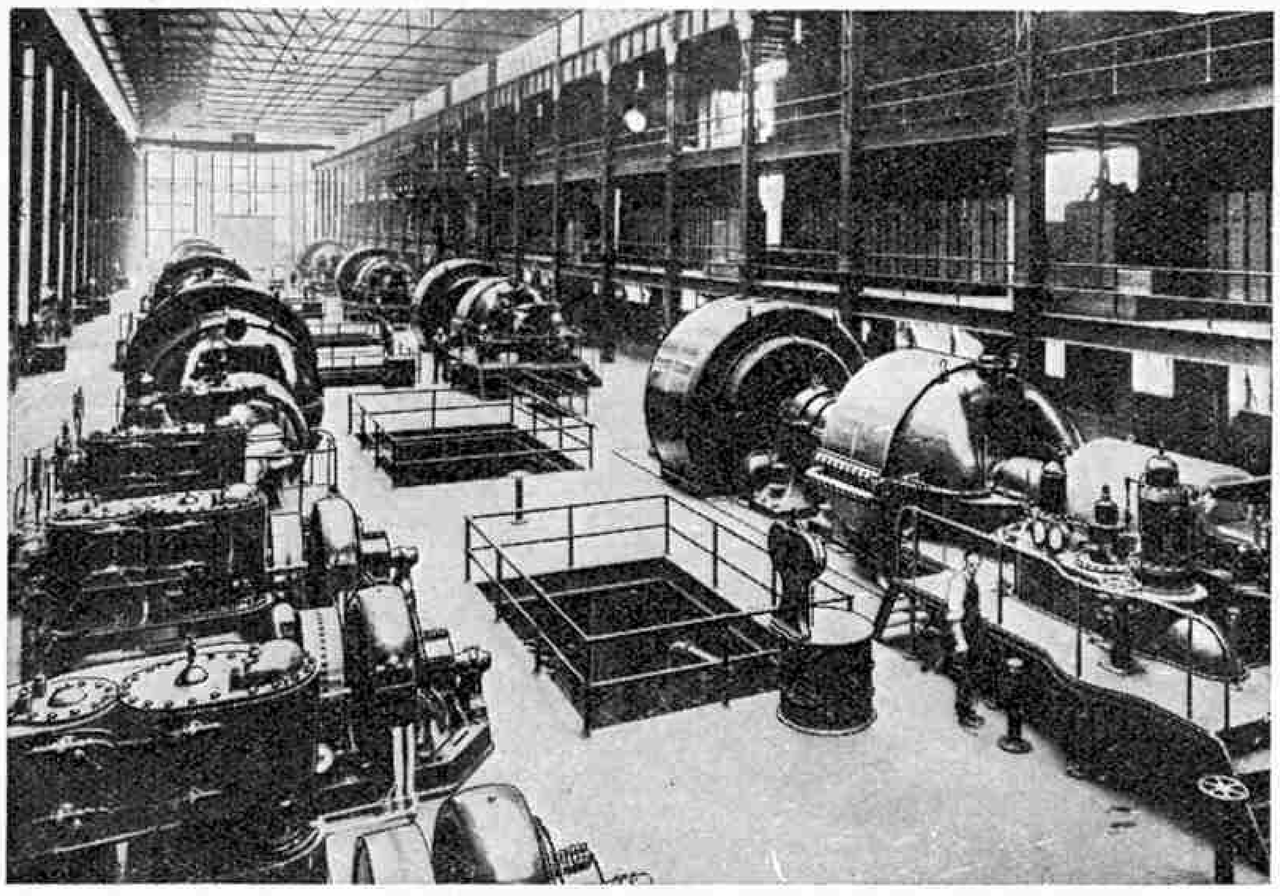
A broken-down train very soon means other trains being held up in all sections behind it and rapidly increasing crowds of passengers waiting on platforms of stations ahead of it. In the event of a breakdown a driver is expected to do whatever is likely to cause the least possible delay to traffic. If he is unable to make good the defect at once he usually can make some sort of temporary adjustment that will enable his train to crawl on to the next station where assistance is available. If, however, his train is badly stuck in the tunnel, the driver of the next train behind may be instructed to come on cautiously and push him out clear to a siding. But whenever a driver gets out of his cab on to the line, whether it is to attend to anything wrong or to shut off the rush of escaping air in front of his cab in the case of a "trip," he must always remember to step as carefully as a cat over the "live" rails and to look out and listen for passing trains.

After Earl's Court there is a sharp curve to the right and two sets of crossover points to the Inner Circle line that runs parallel through Gloucester Road and joins in just beyond South Kensington. Here the train plunges into the first and longest section of the black tunnel. There are no more semaphores and a sharp look-out is kept from the cab for red or orange lights among the double green ones seen along the ground at intervals in the gloom ahead.

The dull-looking old station at Sloane Square has a bad reputation among drivers. It lies at the bottom of a hill in either direction and is on a curve with the outer rail well raised to meet it. These conditions necessitate considerable skill to ensure a good stop, and even experienced drivers may occasionally make a bad shot.

The bright lights of Victoria are come upon very suddenly as the train rounds a curve in the tunnel; then St. James' Park, and Westminster with its sharply curving platform. In this level section of the line, with stations at half-mile intervals, very soon after the controller gets up to the ninth notch after one stop it is time to shut off current again and coast ready for the next stop. During the rush hours when passengers crowd into the train, much stronger braking is required to bring up the train correctly at the stations. If the brakes were worked as they were when running "light" out Acton way, the train would overshoot the mark every time.

At Charing Cross the driver looks out for a purple light that shows up if the leading trip-valve gear is in correct adjustment. If the light fails to show, the gear is adjusted at the first opportunity.



Turbo-Generators at Lots Road Power Station, Chelsea

Now comes a straight, partly open run abreast the Thames Embankment to Temple and Blackfriars. The platforms of these old City stations are very short and care is necessary in order to avoid leaving the tail car partly in the tunnel. On clearing Blackfriars current is shut off and the train is run cautiously down to Mansion House, which has both terminal and through platforms with crossover points and whose signal lights can be seen at the bottom of the hill.

The gloomy part of the old City tunnel after Mansion House and beyond looks very weird and mysterious from the cab. Cannon Street, Monument and Mark Lane come at short intervals. Then the tunnel makes a long continuous curve to the left and signal lights keep appearing suddenly just around the corner. The line out of Fenchurch Street emerging from the mouth of another black tunnel is crossed at right angles. Then come junction lights and a sharp grinding curve to the right into Aldgate East and straight on to St. Mary's.

Here at last the train emerges from the long dark winding tunnels with their glimpses of the sky, and runs into steady daylight. There is a distinct feeling of relief. A clear run of a quarter of a mile in the open now brings us to Whitechapel, where we take leave of our driver, full of admiration not only of the efficiency with which he has piloted his train, but also of the engineering skill manifested in the numerous appliances that ensure the safety of the travelling public.

Binding the "*M.M.*"

Binding cases for back numbers of the Magazine may be obtained from Messrs. O. H. Bateman and Co., 13, North John Street, Liverpool. These are supplied in two sizes (1) for six copies price 3/6 and (2) for twelve copies price 5/3 post free in each case. The binding cases are supplied in what is known as "Quarter Basil, full cloth"—that is to say three-quarters of the sides are dark crimson cloth and the back and a quarter of the sides are dark crimson leather as shown here. The case is tastefully embossed in gold with the name "Meccano Magazine," and on the back is the name and volume number.

Binding the "*M.M.*" These binding cases are supplied so that readers may have their Magazines bound locally, but where desired, the firm mentioned above will bind Meccano Magazines at a charge of 6/6 for six issues or 8/6 for twelve issues, including the cost of the binding and also return carriage. The covers of the Magazines may be included or omitted as required, but in the absence of any instructions to the contrary they will be included.

Whilst the binding of the twelve Magazines is quite satisfactory, they form a rather bulky volume and for that reason arrangements have been made to bind six months' Magazines where so desired, as explained above. Back numbers for

any volume can be bound and the case will be embossed with the correct volume number.

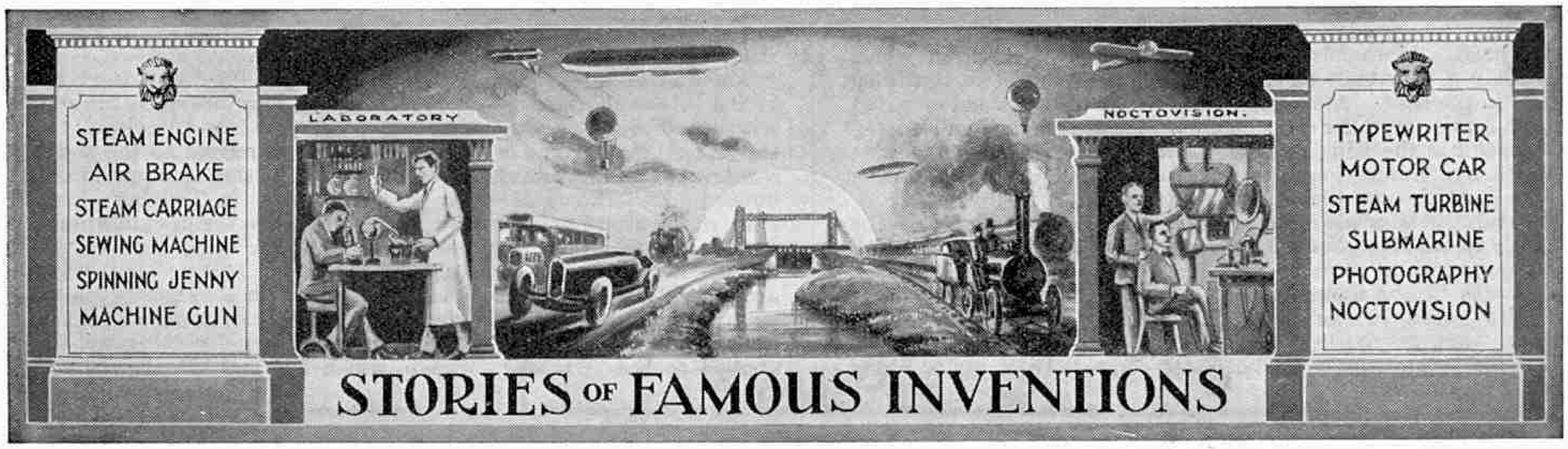
Readers desiring to have their Magazines bound need only make a strong parcel of them, include a note of their name and address together with the necessary remittance, and send the parcel direct to Messrs. O. H. Bateman and Co., 13, North John Street, Liverpool, by parcel post, carriage paid.

Bound Volumes of the "*M.M.*"

Will readers please note that all "*Meccano Magazines*" prior to December 1923 are out of print. Each of the 1924 issues is available, but only the May, June, July, September and December issues of 1925 are in stock. All of the 1926 and 1927 issues are available with the exception of January and February 1926.

Copies of back issues will be sent, post free, price 3d. for issues prior to 1925, 4d. for the issues of 1925 and 1926, with the exception of the December numbers. The December issues, 1925 and 1926, and all the issues of 1927, 8d. The number of copies is very limited and early application should be made.

We can supply a limited number of bound volumes of the "*M.M.*" at the following prices (carriage paid). January-December 1924, in one volume 10/–. July-December 1926, price 8/3. January-June 1927, 9/6. July-December 1927, 9/6.



IV.—THE SUBMARINE

ALTHOUGH the submarine in the sense of a vessel capable not only of remaining under water but also of travelling while submerged is modern, the idea of a submersible vessel is several centuries old. One of the earliest references to submersible boats occurs in the writings of Olaus Magnus, Archbishop of Upsala, Sweden. In an account entitled "Of Leather Ships Made of Hides Used by the Pyrats of Gruntland" he relates that these vessels were used by the pirates "for the purpose of going wherever they wish, either above or below water."

The Archbishop adds that "in 1505 I saw two of these leather boats or skiffs in the Cathedral church, Aslöe, in the western porch. They were dedicated to St. Haluard and placed there on exhibition and are said to have been taken by King Hakon while passing with his warships along the coast of Gruntland, when the pyrats tried to sink his vessels." The Gruntland referred to in this ancient record is generally assumed to mean Greenland, and although the Archbishop did not supplement his remarks with a description of the submersible boats used by the pirates, they are thought to have been simply Eskimo kyaks or canoes covered over with hide. This covering was drawn around the body of the occupant of the boat tightly enough to prevent any water from entering the craft.

A similar dearth of information attaches to the record of a "diving vessel" that was exhibited to the Emperor Charles V at Toledo in 1538, and of a submersible boat that is said to have been used by the people of Venice 20 years later to salvage a sunken galleon.

About 1578 one of Queen Elizabeth's naval gunners named William Bourne proposed to construct a submersible vessel and gave details of his invention in a small book published in 1578, under the title of "Inuentions of Deuises—very necessary for all Generalles and Captaines, or Leaders of Men as wel by sea as by land." Bourne prefaced his description with the statement that "it is possible to make a shippe or boate that may goe vnder the water vnto the bottome and so come vp againe at your pleasure."

Robert Fulton, inventor of the first practicable submarine

According to Bourne's description the vessel was to be of leather and to consist of three superimposed compartments. The top and bottom sections were to be water-tight while the intermediate one was to be "pierced with holes and provided with two longitudinal bulkheads." The vessel was only large enough to accommodate one person, who could cause the boat to sink by drawing inward the bulkheads and admitting sufficient water into the centre compartment, through the perforations in the side of the vessel, to reduce the buoyancy of the craft to the required degree. To raise the boat to the surface again the bulkheads were to be pushed outward, thus causing the water previously drawn into the compartment to be expelled. A hollow mast that projected above the surface of the water was the means of providing the occupant of the boat with a regular supply of fresh air. History does not record whether Queen Elizabeth ever availed herself of Bourne's inventive genius.

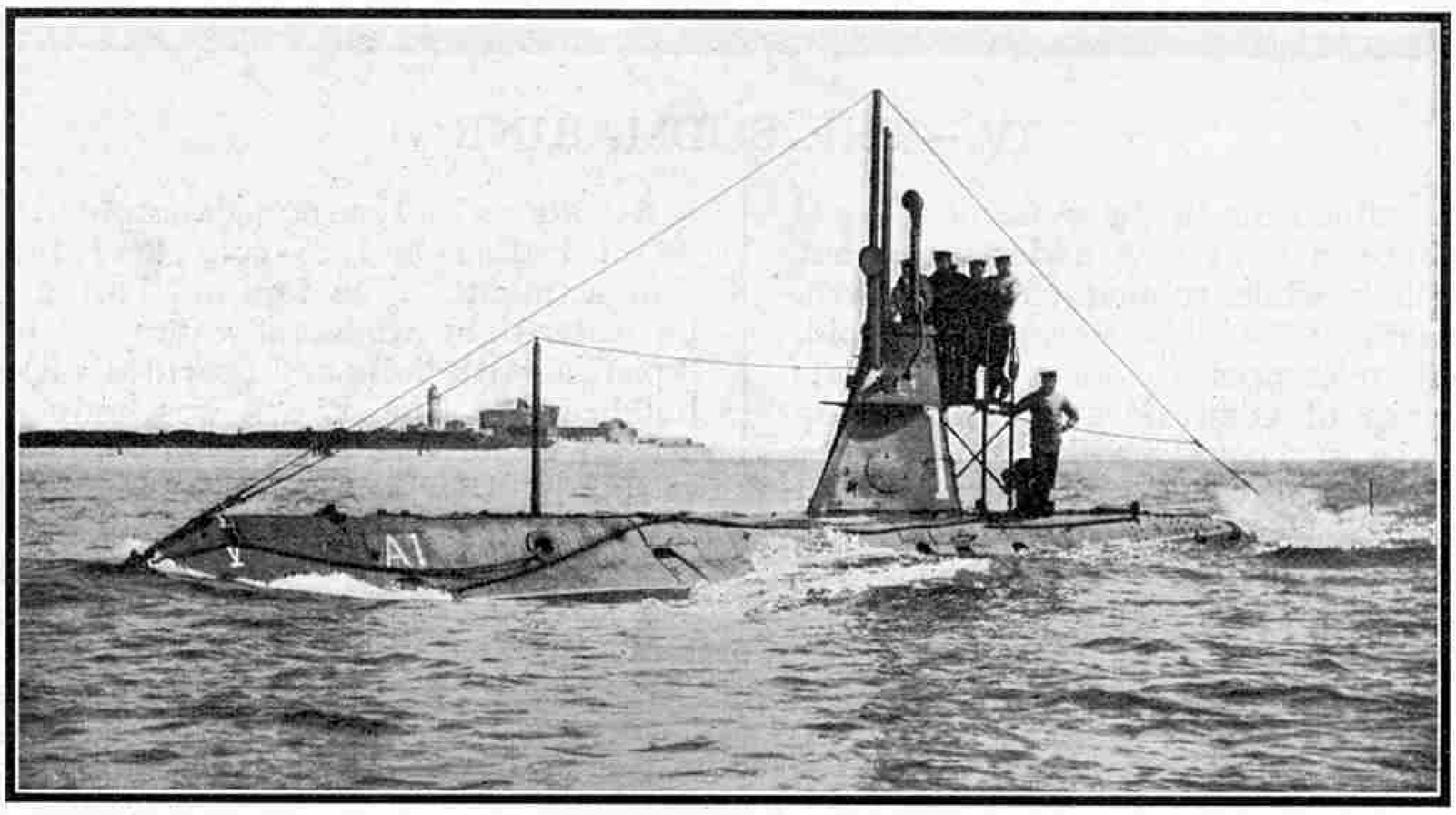
King James I was interested in the subject of submersible boats and he is said to have encouraged one Cornelius Van Drebbel to construct an efficient submarine. Drebbel first conceived the idea of a submarine in 1620, and during the ensuing four years he built three of these craft, one of which is said to have accommodated "12 rowers besides passengers." Details of the construction of Drebbel's submarines are lacking, but a record dated 1645 informs us that the boat just mentioned successfully journeyed under water from Greenwich to Westminster, a distance of two Dutch miles and adds that the vessel could travel "even five or six miles, or as far as one please. In this boat a person could see under the water and without candle light as much as he needed to read in the Bible or any other book." It is recorded of King James that he was so interested in the results of Drebbel's genius that on one occasion he made a voyage in one of the submarines in the River Thames.

Drebbel discovered some means of replenishing the pure air in his closed submarine, but kept his method a close secret. When the air in the submarine became

stuffy he is said to have resorted to a large bottle from which he withdrew a mysterious liquid that had the effect of purifying the air in the boat. After his death in 1634 his heirs endeavoured to obtain this secret for their own use and their efforts culminated in a lawsuit in the King's Court. A reference to this legal contest is made by Samuel Pepys in his famous diary, but nothing is known as to the outcome of the controversy.

A quaintly worded royal warrant dated 1626 reads: "His Majestie to the Master of the Ordnuance, for the makyng of dyvers water mines, water petards, fforged cases to be shot with fireworks, and boates to goe under water." A year later a royal warrant was also issued to the Duke of Buckingham in the following terms: "360 fforged iron cases with fireworks, 50 water mynes, 290 water petards, and two boates to conduct them under water for H.M. present services to goe with the fleete."

About this time several inventors both in this country and in France expounded schemes for constructing underwater craft. Among them were two French priests, Fournier and Mersenne, who in 1634 published a small book in which they detailed their ideas of how a practical submarine should be built. They stated that the submarine should have a metal hull and should be constructed as nearly fish-shaped as possible. Another inventor named Jean Barrie was granted a patent by the King of France in 1640 giving him authority to "fish at the bottom of the sea with his boat" at any time during the ensuing 12 years.



The first British submarine of the "A" class. These vessels were of 180 tons displacement and were capable of a speed of 12 knots on the surface and of 8 knots under water

About 1774 a wheelwright named Day, living in Suffolk, became interested in the subject of submersible boats. He obtained one of the small boats in common use on the Norfolk Broads and equipped it with a covering to render it totally enclosed and to prevent it from filling with water when submerged. In this improvised submarine he made several successful experiments and on one occasion he is said to have succeeded in remaining under water at a depth of 30 ft. for 24 hours.

Day was greatly encouraged by this success, but he lacked the funds necessary to cover the cost of building a larger and improved vessel. He endeavoured to raise the money among his friends but, although they were interested in his experiments they were loth to risk any capital in his ventures. There happened to be in the neighbourhood a man named Blake who had a reputation for making novel wagers, and by artful conversation Day interested Blake in the possibilities of a man being able to remain under water at a considerable depth for a long period without injury or discomfort. Blake then challenged any man to descend into the sea to a depth of 100 ft. in any contrivance and, after being continuously submerged for 12 hours, without any assistance from or connection with the outside world, to rise to the surface again none the worse for the adventure.

Day then accepted the challenge and it was arranged that the event should take place in Plymouth Sound. Day procured a small boat such as he had used during his experiments and in it he built a water-tight compartment. When all was ready Blake was sent for and in his presence a trial was carried out in shallow water. The vessel was submerged six hours before full tide and remained under water until six hours after the turn of the tide. Day remaining shut up in his tiny watertight compartment throughout the period. Having survived this preliminary ordeal he then prepared for the challenged demonstration.

On the appointed day the vessel was towed to an agreed place and special ballast placed on board in sufficient quantity to ensure that it would sink after a certain quantity of water was admitted. The ballast consisted in part of two heavy detachable weights connected with the watertight cabin in such a manner that, at the conclusion of the 12 hours' submersion, Day could detach them and cause the boat to rise to the surface.

An interesting account of the subsequent happenings is given in the "*Annual Register*" of 1774: "Mr. Day provided himself with whatever he thought necessary; he went into the vessel, let the water into her and with great composure retired to the room constructed for him and shut up the valve. The ship went gradually down in 22 fathoms of water at two o'clock on Tuesday, June 28th, in the afternoon, being due to return at two the next morning. He had thirteen buoys or messengers which he could send to the surface at option to announce his situation below; but none appearing, Mr. Blake, who was near at hand in a barge, began to entertain some suspicion. He kept a strict lookout, and at the time appointed neither the buoys nor the vessel coming up, he applied to the '*Orpheus*' frigate which lay just off the barge, for assistance."

In spite of prolonged efforts to locate and rescue Day and his submarine, neither was ever seen again. Probably the boat was too frail to withstand the pressure of the water at the depth to which it descended, and was crushed to pieces.

In the following year an American named David Bushnell completed the construction of a submersible boat that he had planned and commenced to build in 1771. During his school studies in chemistry Bushnell had become greatly interested in the problem of how to discharge effectively explosive powder under water, and had come to the conclusion that a submersible boat offered the best means of accomplishing this.

The vessel built to Bushnell's design resembled the upper halves of a pair of turtle shells joined together, the natural opening where the head of the turtle would be being occupied by a small conning tower by which entry was made into the boat. A false keel consisting of 200 lb. of lead was placed at the bottom of the boat to maintain it in a vertical position. The submarine only accommodated one person, and although there was no arrangement for renewing the supply of air, experiments proved that the occupant of the boat could remain under water for 30 minutes. The vessel was propelled backward and forward by means of a projecting oar situated near the front and rotated by the feet of the navigator manipulating a pedal arrangement. A rudder for steering purposes was fitted in the rear.

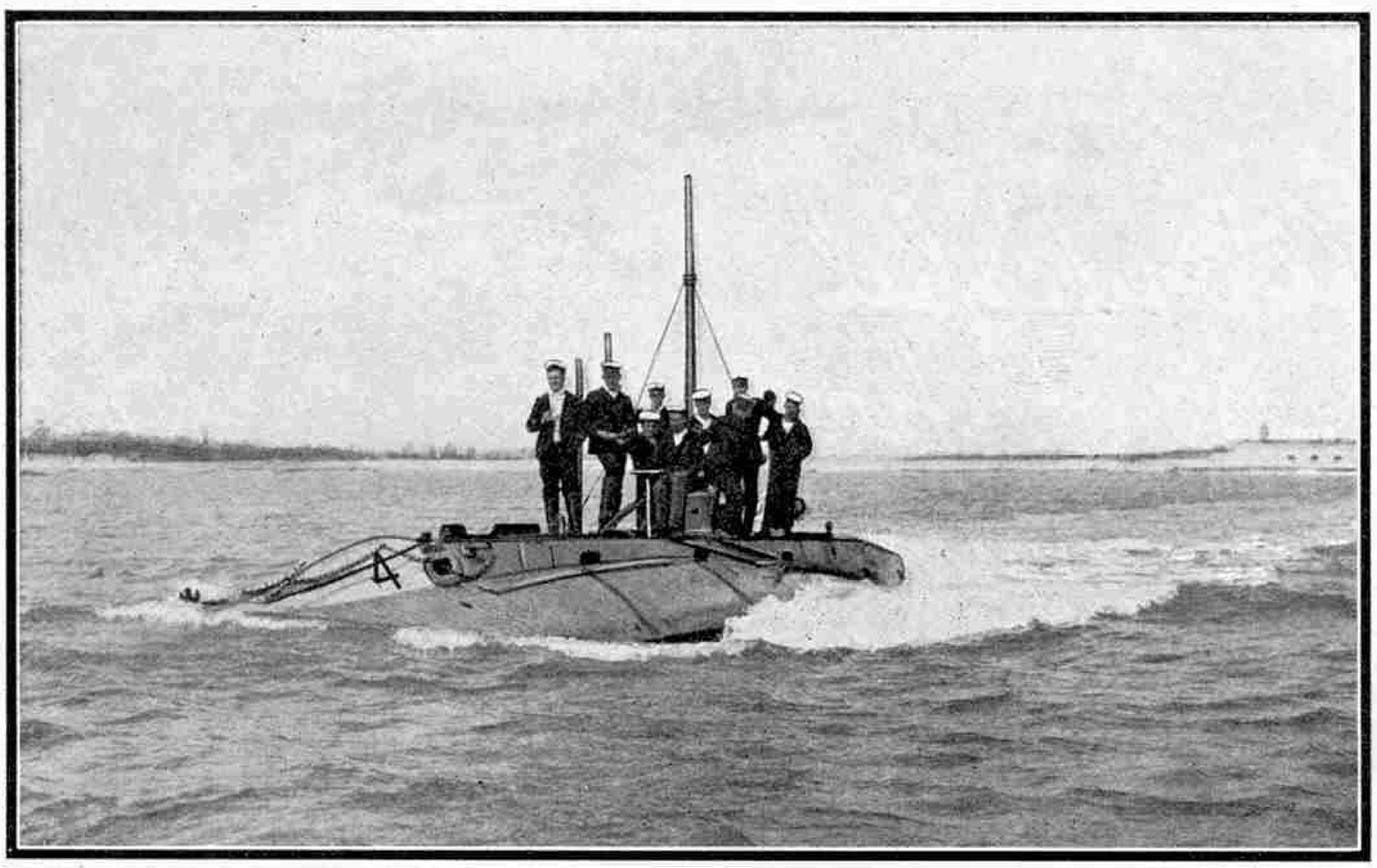
As in the case of Day's submarine, water was relied upon to start the boat sinking, and this was effected by opening a valve in the bottom of the vessel. When sufficient water had been admitted to achieve the desired object, downward progress was continued by an oar, functioning as a vertical screw, that was fitted in the top of the boat. To elevate the submerged boat the water was ejected by means of two force pumps. The compartments set aside for receiving the water corresponded to the water ballast tanks of a modern submarine. The extent to which the submarine descended or rose was registered by a water gauge, while a compass furnished the means of keeping the vessel on a desired course. As there was no means of illumination, this compass was treated with phosphorous so that the navigator could see it in the dark.

This vessel was designed to function as a war unit and was provided with a magazine charged with explosive powder, the idea being to silently approach the vessel selected as the submarine's prey, attach the magazine to the ship's hull and subsequently fire the charge. A device that resembled a huge screwdriver and carried a screw loosely attached to its upper end was fitted to the top of the submarine in such a manner that the occupant could manipulate the screw while the boat was submerged. The magazine of explosive, together with a clockwork mechanism by means of which the powder could be fired at a pre-arranged time, was attached to one end of a short cord, the other end of which

was fastened to the screw.

Owing to ill health Bushnell was unable to operate his submarine when it was completed and his brother was trained to undertake this task. At this time the American War of Independence was in progress and Bushnell decided to test the efficiency of his craft at the expense of some of the British warships then in New York Harbour. He selected the Warship "*Eagle*" as his first victim and arrangements were made for his brother to utilise the submarine to torpedo the British vessel. Before the appointed time for the venture Bushnell's brother also became ill and his place was taken by a nam named Ezra Lee who had already had experience of the working of the submarine.

Boarding the submarine as it lay alongside the parent ship in the Hudson River, Lee began his hazardous exploit and skilfully navigated his boat until it was close to the unsuspecting warship. "When I rode under the stern of the ship," he afterwards related, "I could see the men on deck and hear them talk. I then shut down all the doors, sunk down and came up under the bottom of the ship." Lee then operated the screwdriving device and the screw began to pierce the wooden keel of the warship. A small iron plate or bolt fastening the ship's rudder in place prevented the screw from taking hold, however, and as the tide slowly carried the submarine away from the hull of the ship the screw came away from its socket. Lee endeavoured to locate a more vulnerable part of the hull for the screw, but in his manœuvres he eventually completely lost all trace of the warship.



One of the first five British submarines. These were built in 1901-2 and were of only 120 tons displacement

Rising to the surface again he was dismayed to find that dawn was breaking, and fearing that he would be observed by those on board the warships, or by the garrisons at the Forts, he made a hasty return to the parent ship. During his retreat he located the "*Eagle*" again, and while passing it he was seized by a sudden fear that he had been seen. He immediately discarded the magazine, which was at once carried away by the tide. The magazine had floated a considerable distance from the warship by the time the charge exploded an hour later, but the loud report and the great column of water that shot into the air caused considerable alarm on board the warship.

The "*Eagle*" incident roused the British to the need of greater watchfulness and the work of the submarine was thereby rendered more difficult and dangerous. Two further and unsuccessful attempts to blow up the warship were made before the British succeeded in tracing the submarine to its lair. The parent ship with the tiny under-water craft aboard was then pursued and sunk, but Bushnell later successfully salvaged the submarine.

If the navigator of Bushnell's vessel had achieved his object the submarine would have been proved an efficient weapon of war and its inventor hailed as a genius. As it was, the American authorities remained sceptical as to the merits of the invention. Bushnell became discouraged by their lack of faith and eventually he went to France, only to find that the French Government were equally unenthusiastic. Later he returned to America and, settling in Georgia under an assumed name, gave up his submarine experiments and practised medicine.

George Washington, the first president of the United States, wrote to Thomas Jefferson, who became the third president, regarding Bushnell's invention: "I thought, and still think, that it was an effort of genius, but that too many things were necessary to be combined to expect much from the issue against an enemy who are always on guard." Washington described Bushnell as a "man of great mechanical powers, fertile in genius, and master of execution."

The utility of the submarine as a weapon of war was realised by the famous American engineer Robert Fulton, who was one of the pioneers of steamships. In 1797 Fulton went to Paris and began to experiment with submersible boats and submarine torpedoes. His first submarine was of cigar shape and was called the "*Nautilus*." This vessel was launched on the Seine near Rouen on 30th July, 1800. It did not satisfy Fulton, however, and a second and improved submarine was constructed almost immediately afterward.

This vessel also was named the "*Nautilus*" and was completed in May 1801. It was 21 ft. 4 in. in length and 7 ft. in diameter amidships. The hull consisted of a framework of iron ribs covered with wood sheathed with copper, while a horizontal keel extended the whole length of the boat to give increased stability. The vessel could accommodate two men and entrance was effected by way of a small dome-shaped conning tower that surmounted the forepart of the hull. A short mast that could be laid flat on the deck when not in use was provided to enable the boat to travel on the surface of the water by sail when conditions were favourable.

When submerged, the boat travelled under the impulse of a small propeller at the stern, mounted at the end of a shaft that was rotated by a hand-wheel in the navigator's compartment. A rudder was fitted for steering, while compressed air was provided in sufficient quantity to enable the occupants to remain under water for several hours. Submersion was achieved by admitting water into special compartments, or ballast tanks, and the magazine of explosive carried was similar to that devised by Bushnell, as was also the method of discharge.

When the improved "*Nautilus*" was completed, Fulton tested it in the Seine near Paris and later journeyed in it to Brest. It is said that the gunners in the French forts that he passed were thrown into "fits of consternation" by the sight of the vessel periodically disappearing beneath the surface of the water and suddenly coming up again some distance ahead!

Fulton offered his submarine to France without success, but later Napoleon was sufficiently impressed by it to grant him £250 with which to continue experiments.

The tests carried out at Brest were witnessed by the authorities of the French Marine, and the manœuvres included the sinking of a pontoon by attaching to it a magazine and firing the explosive from an under-water position. Although the pontoon was successfully blown up, the authorities were not satisfied and they requested Fulton to carry out a similar exploit on a much larger scale. He then undertook to sink a British warship, but although he waited for a considerable time none appeared in the vicinity. As the days passed without the required feat taking place the authorities and Napoleon lost all interest in the submarine, and when Fulton subsequently applied for further funds for his experiments he met with a very cold reception.

If Napoleon had realised fully the capabilities of the submarine the outcome of the battles of the Nile and Trafalgar might have been very different. A touch of irony is given to the situation by the fact that when Napoleon was banished to St. Helena a submarine was built in America for the purpose of rescuing him, but he died before the vessel could set out on its mission.

After his failure to induce the French to adopt his submarine Fulton visited England and endeavoured to impress the British authorities with the merits of the

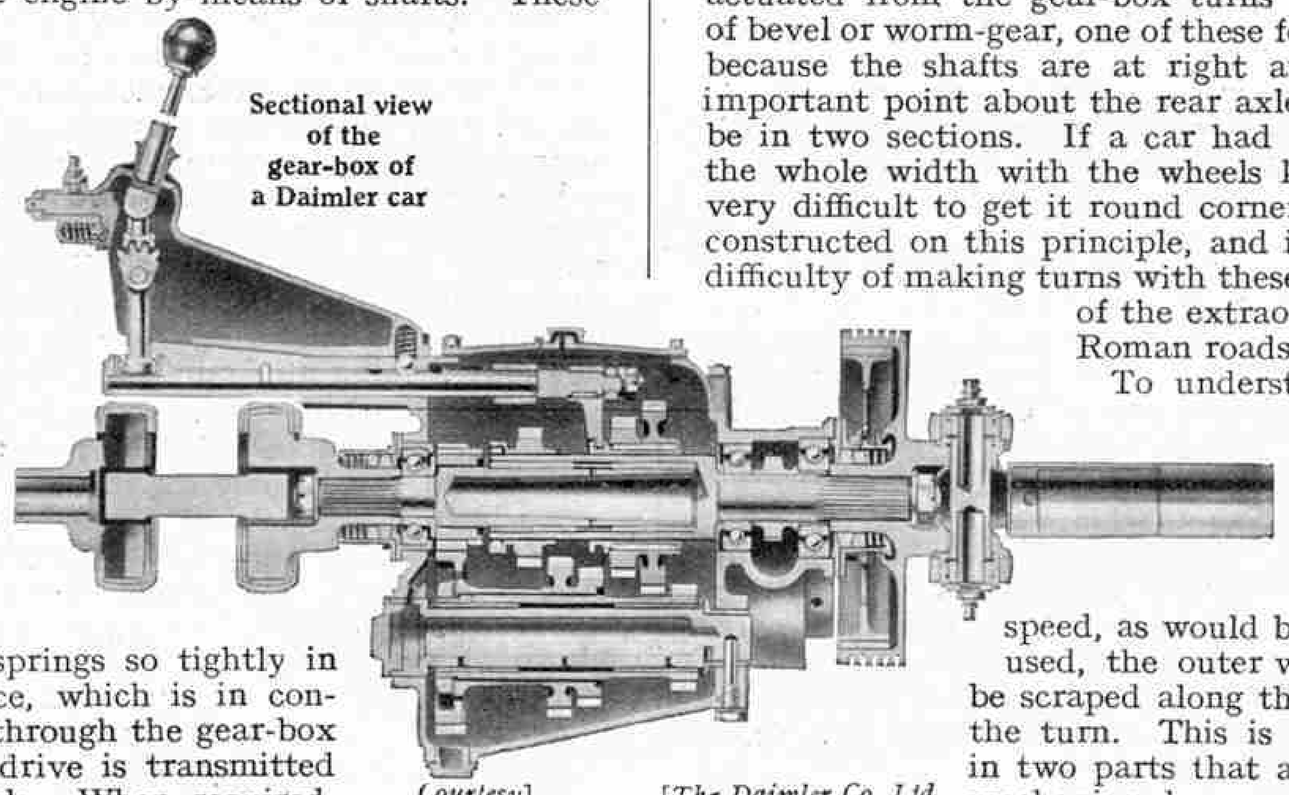
(*Continued on page* 618

The STORY OF THE MOTOR CAR

V.—HOW THE POWER OF THE ENGINE IS USED

THE mechanism of the engine of a motor car has been described fully in the previous articles in this series and now we have to consider how the power of the engine is utilised to make the car move.

Stated in the simplest manner the process is this—the engine turns the crankshaft and the rotary motion of the latter is communicated to the road wheels through the transmission, as it is usually called. This mechanism consists of three parts connected with each other and with the engine by means of shafts. These three parts are the clutch, the gear-box, and the rear axle respectively.



Sectional view of the gear-box of a Daimler car

Courtesy [*The Daimler Co. Ltd.*

The clutch is nearest the engine and is the means whereby the rotation of the crankshaft is transmitted to the rest of the mechanism of the car. Occasions are continually arising in driving when it is necessary to bring a car to a stop with the engine still running, and it is the purpose of the clutch to enable this to be done at the will of the driver. The principle is quite simple. A disc or surface driven by the engine is normally held by springs so tightly in contact with a second surface, which is in connection with the rear wheels through the gear-box and the rear axle, that the drive is transmitted from the engine to the wheels. When required, however, the second surface can be moved out of contact by the driver, thus cutting off the engine from the driving wheels.

Following on the clutch comes the gear-box. This is a more complicated piece of machinery designed to help the engine to do its work under various conditions. The power required to propel a car up a steep hill is more than is necessary for running on the level. When an engine shows signs of failure in hill-climbing, a lower gear is engaged. This means that the drive is taken through the gear-box by a new train of gear-wheels that increase the number of revolutions of the crankshaft of the engine required for each revolution of the road wheels. Thus, if the ratio is 4½ to 1 in normal running on the level, an alternative gear system may alter this to 7 to 1 or even further.

The usual rule obtains that what is gained in power is lost in speed. On the level the car is capable of much greater speed in what is known as top gear than when any of the others is engaged. As a rule, the gear-box of a car provides either three or four different speeds. In addition it contains the gears necessary for reversing the drive, as the direction of rotation of the crankshaft of an internal combustion engine cannot be altered.

Finally comes the method of driving the road wheels. A shaft actuated from the gear-box turns the rear axle shaft by means of bevel or worm-gear, one of these forms of gearing being necessary because the shafts are at right angles to each other. A very important point about the rear axle shaft of a car is that it must be in two sections. If a car had a simple shaft extending over the whole width with the wheels keyed to its ends, it would be very difficult to get it round corners. The Roman chariots were constructed on this principle, and it has been suggested that the difficulty of making turns with these vehicles was one of the causes of the extraordinary straightness for which Roman roads were famous.

To understand the difficulty, imagine a car actually turning a corner. The outer wheel of the rear pair must travel over a greater distance than the inner wheel. If the two could only rotate at the same speed, as would be the case if a single shaft were used, the outer wheel would necessarily have to be scraped along the ground in order to complete the turn. This is avoided by making the shaft in two parts that are connected by a remarkable mechanism known as the differential gear. With this the wheels are able to rotate independently and at different speeds, but the drive is transmitted equally to them when the car is running straight.

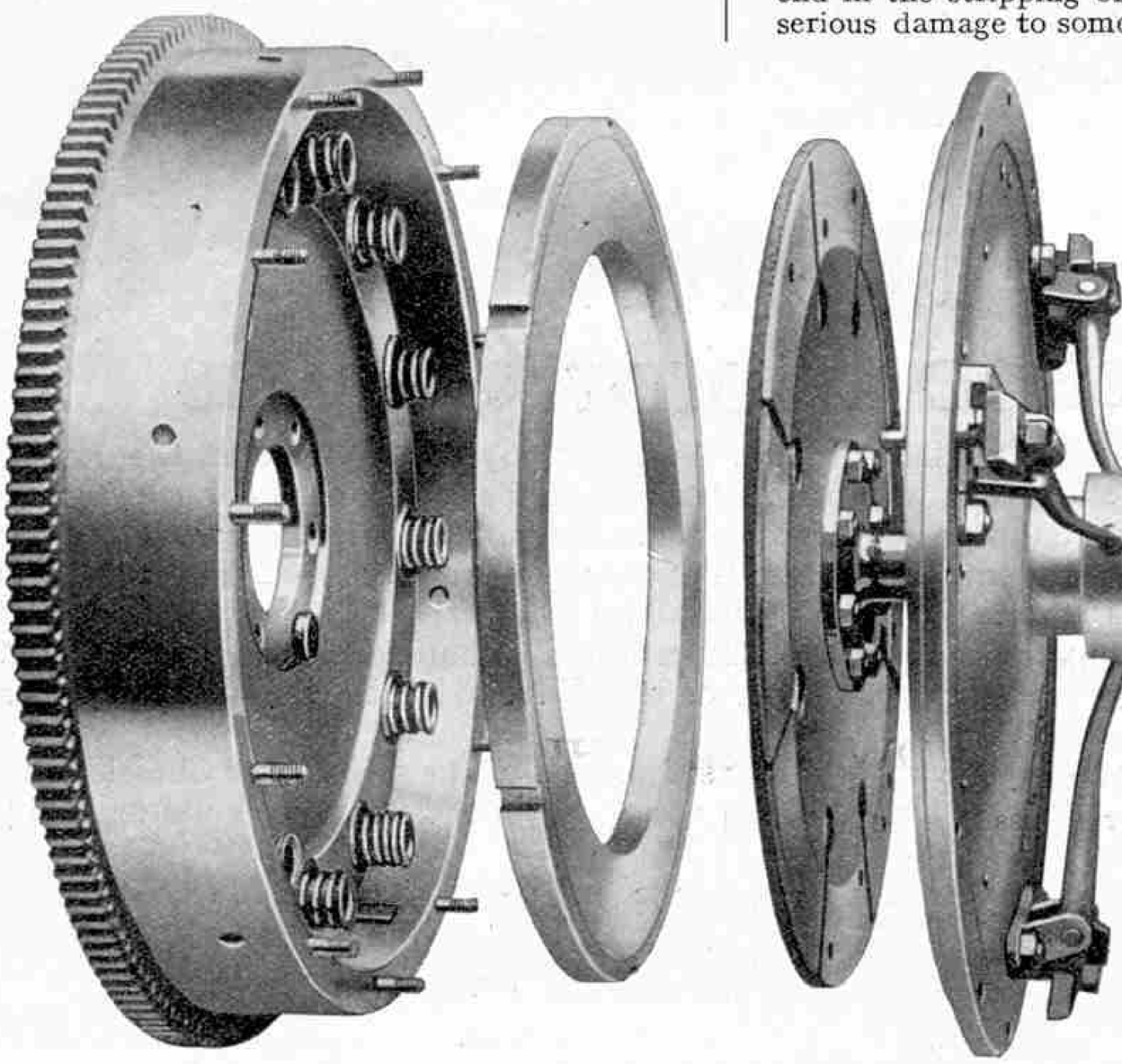
The various parts of the transmission and the rotating shafts connecting them must not be rigidly joined to each other in spite of the fact that the shafts are practically in line, as the car is subject to road shocks. To retain sufficient flexibility to prevent breakage through distortion of the framework due to this cause, the necessary connections are made by joints that allow a little play. These are called universal joints.

The parts of the transmission, the work of which has now been briefly noted, vary considerably in construction, if not in principle. In the present article it is proposed to deal with the forms in which

they appear in modern vehicles.

The first item in the transmission is the clutch, or the mechanism that enables the engine to be coupled to or uncoupled from the rest of the driving gear of a car. It is incorporated with the flywheel of the engine, which is mounted on the rear end of the crankshaft to serve the usual purpose of assisting to maintain steady rotation by the centrifugal force that it exerts. This is of great importance in the case of an internal combustion engine, in which the power impulses are spasmodic.

Two general forms of clutch are in use, and in both cases use is made of friction. The older of these is the cone clutch, which is still very largely employed. In this type the flywheel is partly hollowed out and the interior given a tapered surface. A cone-shaped casting of steel or aluminium, with a surface that is designed to fit closely on the tapered surface, slides on a splined shaft leading to the gear-box. The latter shaft is in line with the engine shaft, but separated from it by a short interval. On the surface of the cone strips of leather or a special fabric are riveted and it is these strips that come into actual contact with the flywheel. A spring holds the two surfaces in contact, with the result that the rotating flywheel carries the cone with it owing to the friction between them, and thus rotates the gear shaft.



Courtesy [*The Daimler Co. Ltd.*

The parts of a typical single-plate clutch ready for assembly. The clutch springs on the inside of the flywheel are clearly visible

The cone sliding on the gear shaft is forced out of contact with the flywheel by the depression of the clutch pedal. This pedal is fixed on one arm of a lever, the other arm of which ends in rollers that press on some portion of the face of the cone. So long as the clutch pedal is depressed there is no connection between the crankshaft of the engine and the gear shaft, but as the pressure on the pedal is released the spring brings the surfaces of the clutch members into contact once more.

The cone clutch may take one of two forms. In one the cone is simply pulled out from the flywheel to disengage it, while in the other the taper is cut on the inner surface of the flywheel in such a manner that the cone moves inward to bring about this result. The internal cone clutch, as it is called, is simpler from a mechanical point of view and is now very largely used.

The plate clutch is coming rapidly into favour, especially in the single-plate form, which is predominant nowadays. Its action will be readily understood on reference to the illustration on this page showing the parts of the clutch fitted to several cars of the Daimler range. The two essential parts are a sliding ring or annular plate, which is keyed to the flywheel shown on the left, and a fabric-lined plate that terminates the gear shaft. The two plates are kept in contact with each other by springs on the inside of the flywheel, the number and position of which ensure an even, steady contact over a large area.

When the clutch pedal is depressed, three levers pivoted on the cover plate shown on the right of the illustration come into operation. The outer ends of the levers press on sliding pins that pass through the holes that can be seen in the fabric-lined plate and push the sliding plate out of contact.

The multi-plate clutch is similar in principle and construction to the single-plate type, several driving and driven plates being arranged alternately. This type is now largely used on American cars and appears to be gaining favour. In a few cases the plates run in oil. Fabric lining cannot then be used, as the fabric would swell considerably on absorbing the oil. A considerable number of plates is necessary to give the required frictional surface in a clutch of this kind, but the oil is useful in preventing over-heating, while in addition it interposes between the plates like a cushion and thus assists in obtaining smooth engagement.

A few words on the manipulation of the clutch of a motor car may not be misplaced. Movements of the pedal should be made carefully and gradually. When a driver merely removes his foot from the pedal the powerful clutch spring immediately brings the surfaces into violent contact, with one of two results. If the engine is running slowly the sudden application of the load stops it altogether—a mistake very often made by novices on restarting after a traffic jam. On the other hand, if the engine is running at high speed, a violent impulse is transmitted to the mechanism behind the clutch in a jumpy and spasmodic manner that may end in the stripping of teeth from a gear-wheel or even in more serious damage to some other part of the chassis.

When the pressure on the clutch pedal is released smoothly, a certain amount of slipping takes place between the engaging surfaces before the cone attains the speed of the flywheel. The result is that the gears and shafts of the rest of the transmission begin to move gently and without injury. The process of starting may then be completed by careful acceleration. Mastery of the clutch is one of the marks of a practised and skilful driver.

Turning now to the gear-box, the second main item in the transmission, the reason for its existence may first be more fully examined. A motor car engine is not flexible in the same sense as is a steam engine. The driver of a locomotive has the full pressure of the steam from the boiler at his command always—providing of course, that firing is efficiently performed—and can control its use in the cylinders by means of the throttle over a very wide range of speeds. Thus he has the same power under his control whether his engine is moving slowly or at maximum speed.

With the internal combustion engine, on the other hand, the power output is practically dependent on the speed of the engine, as it is produced by a fixed number of explosions in each revolution. As a car slows down, therefore, the power output is reduced. In hill-climbing this is a serious matter, as it is just then that extra power is demanded. To overcome the difficulty some means of keeping up the engine speed must be used, and as already noted this is done by altering the gear ratio.

The gear-box contains the necessary shafts and gear-wheels to enable this change to be made when necessary while the car is actually running. The devices that have been invented for the purpose are very numerous, but on practically all cars a method is now used that was first introduced on the famous Panhard-Levassor car, as explained in the first article in this series.

The modern gear-box contains four shafts, one of which is only required to carry the reverse pinion that will be referred to later. The remaining three are the gear shaft driven through the clutch by the engine, the driving shaft, which is connected to the rear axle, and the lay shaft. The two former are in line but rotate independently, the driving shaft being usually bushed in a recess in the end of the gear shaft, while the lay shaft is placed beneath the two and is driven from the gear shaft by toothed wheels that are in constant mesh. The sectional drawing of a gear-box on page 578 will make this clear, the gear wheels that are always in mesh being shown on the left of their respective shafts.

The lay shaft rotates more slowly than the gear shaft and is always rotating when the engine is running and the clutch is engaged. On the lay shaft of the gear-box illustrated, which is of the four-speed type, there are three fixed gear wheels of different sizes, and it is through these that the drive is carried to the driving shaft, except when the car is running under normal conditions on what is known as top gear, the complete meaning of which will be apparent later.

Gear wheels are fitted on the driving shaft to correspond with those on the lay shaft, but there is an important difference between

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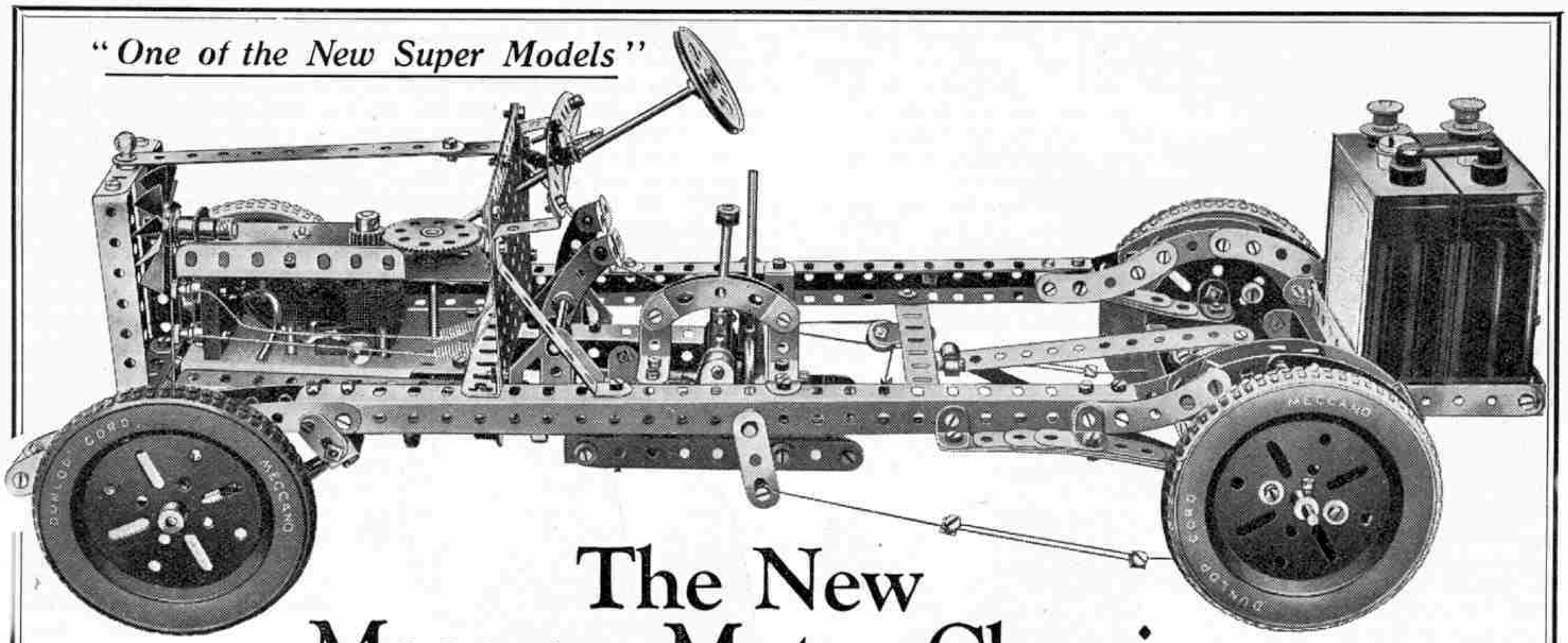

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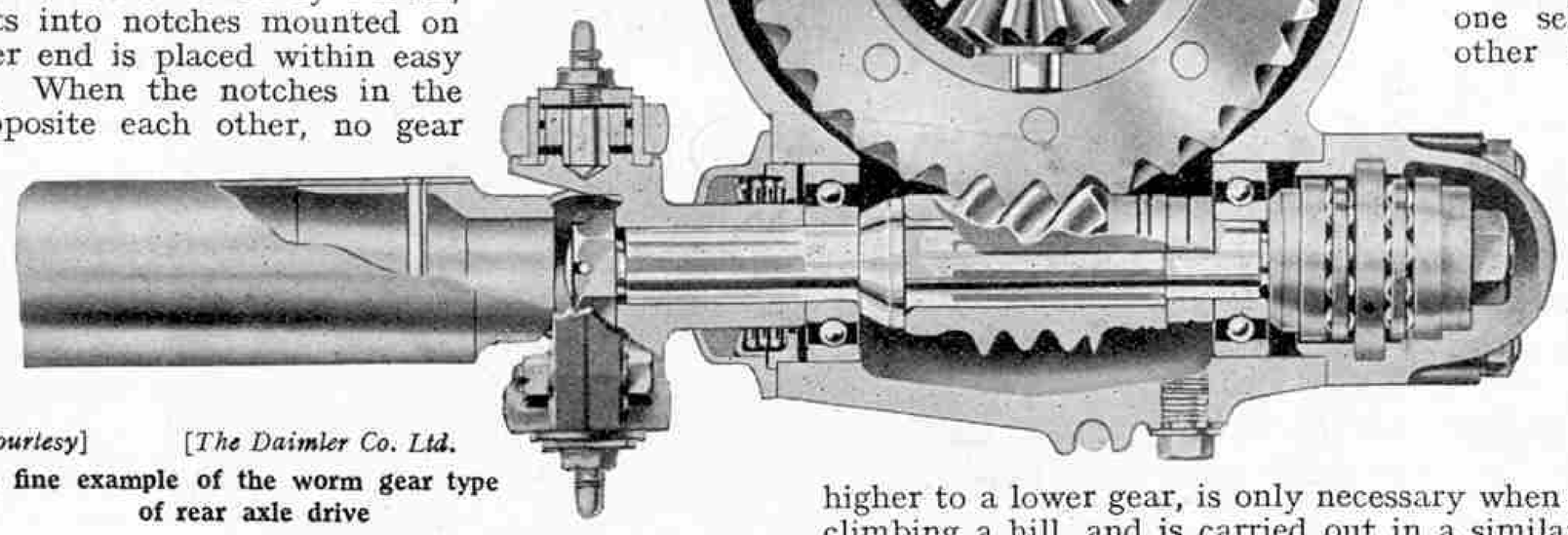
them. Those on the driving shaft are not fixed but are threaded on so as to be capable of a sliding movement. To enable them to bring about rotation of the driving shaft at the same time, the latter is either made square in cross section, or is splined, this expression meaning that longitudinal projections run along the shaft that fit into corresponding recesses in the central openings of the gear wheels. These sliding gears are usually made in pairs and are so placed that they come into mesh with the corresponding gears on the lay shaft when moved to left or right of their normal or "neutral" position.

The three sets of gear wheels so far referred to give three of the four speeds provided in the gear box illustrated. In addition a direct drive is obtained by engaging gears on the end of the gear shaft with an internal gear wheel sliding on the driving shaft. This gear wheel and the one of the normal type required for the next speed are usually cut together.

To move the sliding gears, arms project from bars fixed either at the side or on top of the gear box. Two bars are provided, one for each pair of sliding gears, and as they are used to select the particular gear to be used for transmitting the drive, they are usually known as selector bars. They are placed side by side and are moved by a lever, one end of which fits into notches mounted on them, while the other end is placed within easy reach of the driver. When the notches in the selector bars are opposite each other, no gear wheels are engaged and the gears are said to be in "neutral." The end of the lever may then be moved easily from one bar to the other, thus enabling a driver to select the gears he intends to engage.



Courtesy [*The Daimler Co. Ltd.*

A fine example of the worm gear type of rear axle drive

Backward or forward movement of the lever brings a pair of gear wheels into mesh. To enable the driver to see what he is doing an H-shaped slot is usually provided to act as a guide for movements of the lever. This slot is usually described as the "gate." It is useful, but not absolutely necessary once a driver has become familiar with gear selecting and changing. On many cars it is now omitted, but in these cases the lever is mounted on top of the gear-box and acts directly on the selector bars. It is in fact a simple lever, pivoted on a ball and socket joint as fulcrum. Gear changes are then made with the left hand.

The central gear lever originated in America, where traffic keeps to the right and the driver sits on the left of his vehicle, in which case the change is made with the right hand. On most English cars the gear lever is placed at the driver's right hand, and is connected with the rod that moves the selector bars by a cross shaft.

To understand how the gears work, the process of starting a car may be followed as far as it affects the gear-box, as this operation usually involves the use of all gears in turn. In the illustration on page 578 it will be noticed that the gear wheels on the lay shaft become smaller from left to right, while those on the driving shaft become larger. The lowest or first gear, that is the one for which the ratio of road speed to engine speed is least, is obtained by bringing the smallest lay shaft gear wheel into mesh with the largest on the driving shaft. To start the car, therefore, the driver first depresses the clutch pedal and moves the gear lever from the neutral position, in which no gears are in mesh, into the notch of the gate marked 1, or into the corresponding position when no gate is fitted. In the case of the gear-box illustrated, which is of the ball-change type, the knob of the lever is moved forward and this movement slides the rear pair of gears backward to bring these two gear wheels into mesh. The driver cannot actually see what is happening, of course, as the floor boards of the car and the gear-box itself intervene, but the positions of the levers necessary must be learned beforehand.

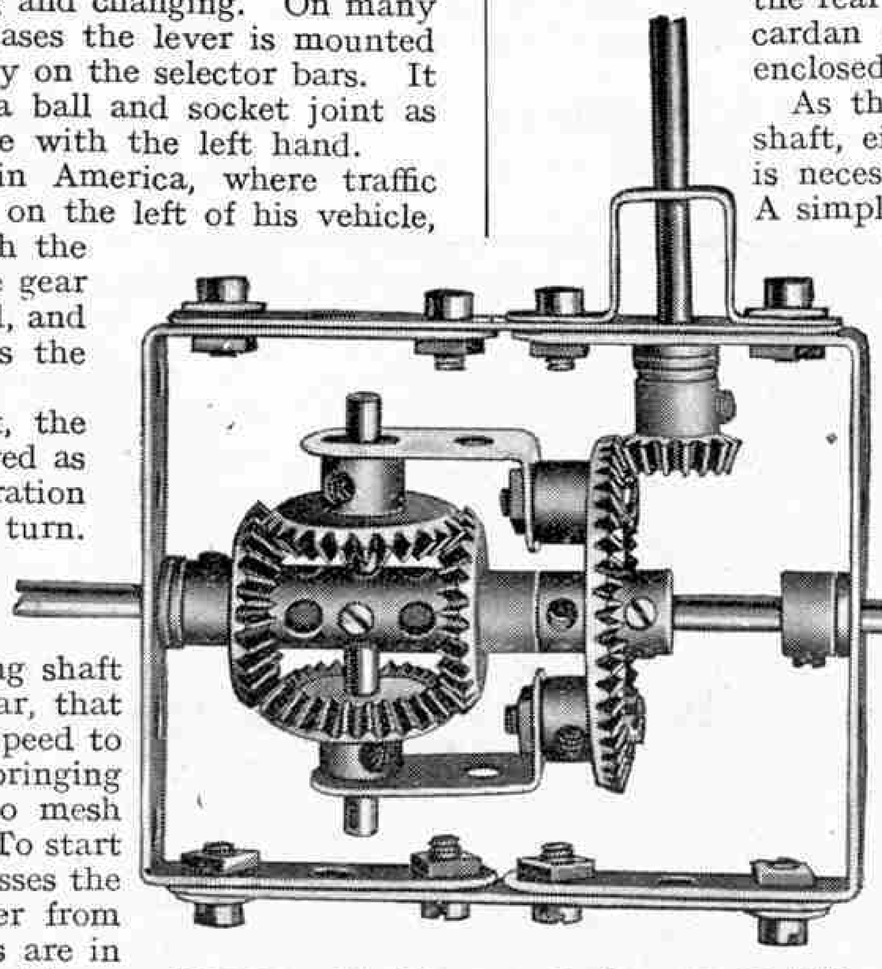
When the gears are engaged the driver "lets in" the clutch smoothly, and as the drive is taken up it is transmitted from the gear shaft to the driving shaft by way of the lay shaft and the gears that have been brought into mesh. The car may now be accelerated and, when a reasonable speed has been attained, preparations made for engaging the next gear. To do this the driver once more disengages the clutch and moves the lever from the notch marked 1 to that marked 2. This disengages the gear wheels already in mesh and brings the next pair into mesh. The lay shaft gear wheel now in use is a little larger and the driving shaft gear wheel is a little smaller, so that the ratio of road speed to engine speed is greater. When the position of the lever in the notch shows that the new gears have been engaged, the clutch may once more be let in.

The two following changes are made in exactly the same manner, but will necessarily be made at greater speeds. In passing from the second to the third gear the lever must be moved through the gate, that is through the part corresponding to the horizontal line in the letter H. This means that a change is made from one selector bar to the other in the gear-box. When the last change has been made the car is in "top gear," that is the gear wheels giving the highest ratio of road speed to engine speed are now in mesh.

The reverse process, that is, changing down from a higher to a lower gear, is only necessary when a car loses speed in climbing a hill, and is carried out in a similar way. It is very seldom that a lower gear than third with a four-speed gear-box—or second with a three-speed gear-box—is required.

The driving shaft of the gear-box projects through the rear wall of the box itself and is connected by universal joints with a longer shaft by means of which the drive is carried from the gear-box to the rear axle. This is referred to as the propeller or cardan shaft, which is exposed in some cars and enclosed in a wide tube in others.

As the rear axle is at right-angles to the cardan shaft, either worm gear or some form of bevel gear is necessary to cause the rear axle shaft to rotate. A simple form of bevel gear is used in the Meccano Motor Chassis, the drive of which is illustrated on this page. In it a small bevel gear wheel engages with a larger bevel on the rear axle. In normal motor cars with direct drive on top gear, it is here that gear reduction is brought about. By providing bevel gears with diameters in the ratio of 1 to 5, for instance, the road wheels may be made to rotate once only for each five revolutions of the engine, the ratio being reduced still further when lower gears are engaged in the gear-box.



Meccano model of the rear axle of a motor car. This illustrates the bevel gear type of drive

The type of rear axle drive used in the Meccano Chassis is what is known as a straight bevel, the teeth being cut along lines radiating from the centre of the gear wheel. In this type almost the whole of the drive at any given moment is being transmitted by one tooth on each wheel only. The straight-toothed bevel drive therefore has been superseded by the spiral bevel drive, in which the teeth of both gear wheels are curved in such a manner that more than one pair of corresponding teeth are always in engagement. The overlapping action thus obtained is not only more continuous but more silent also. In an interesting gear of this type, known as the Citroen gear, the teeth are V-shaped, a herring-bone appearance being given, especially to the larger bevel, by the succession of teeth of this shape.

The worm gear type is well illustrated by the accompanying sectional photograph of the Daimler rear axle. A hardened steel screw driven by the propeller shaft engages either the top or the bottom of a phosphor bronze worm wheel on the rear axle. In a well-designed drive of this type the (*Continued on page* 583)

Trevithick's Home to be Preserved:

A Memorial of an Ill-Fated Inventor

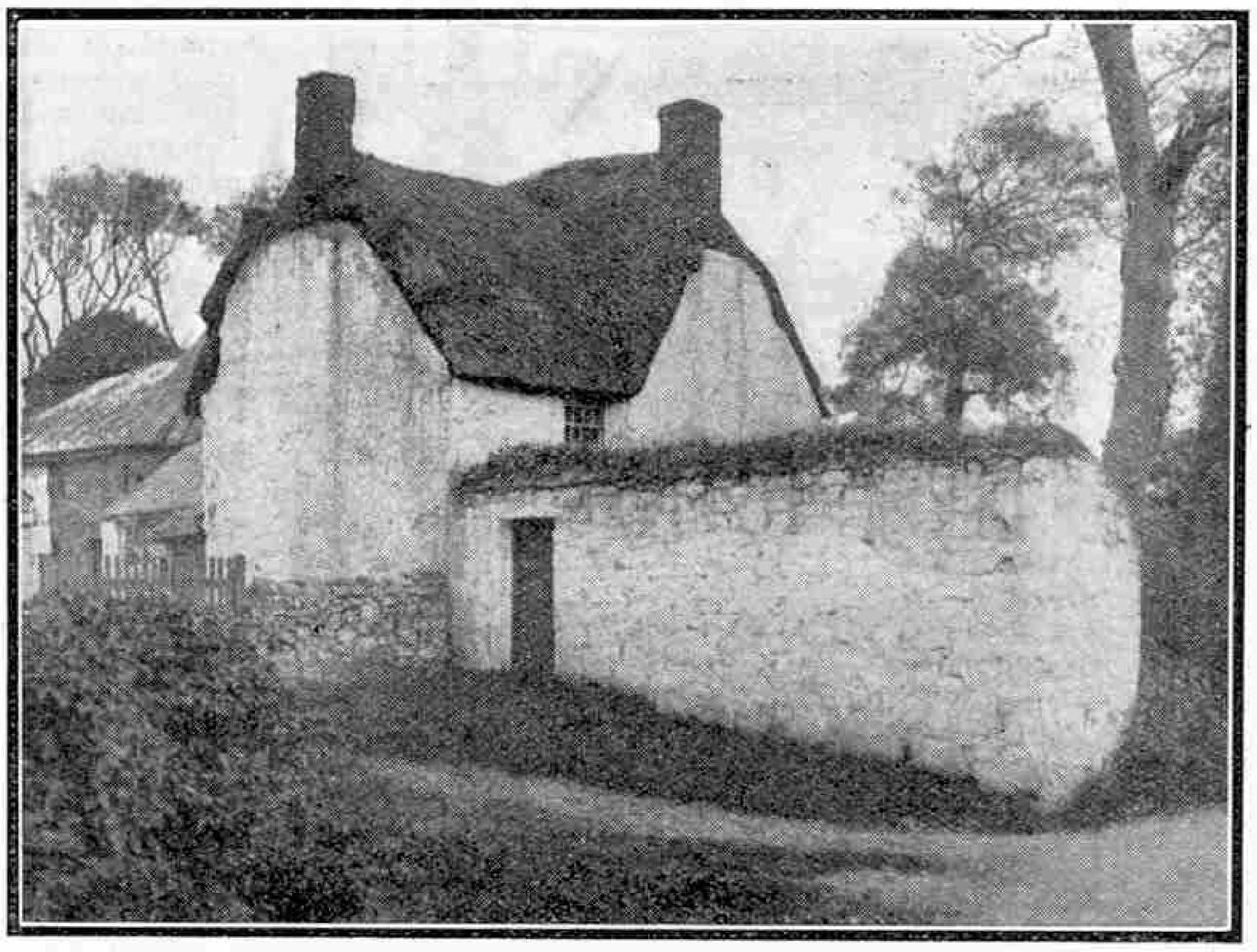
THERE is always a great deal of interest attached to the house in which a famous man has lived and worked, and it is a melancholy fact that so few of these houses survive. Very often they have been demolished to make room for other buildings demanded by modern conditions of life, and in other cases they have been allowed to fall into ruin and decay through sheer indifference on the part of the general public. It is all the more pleasant, therefore, to come across an example to the contrary.

Richard Trevithick, the brilliant but ill-fated inventor, lived as a small boy in a thatched house at Penponds, Camborne, Cornwall, and this house was his home until his marriage in 1797 and also at subsequent periods of his life. This interesting relic is not to be allowed to crumble into ruin, but it is to be handed over to a Public Trust to be carefully preserved and converted into a Trevithick Museum.

Trevithick's home at Penponds, Camborne, which is to be preserved and converted into a museum

Trevithick was an extraordinary man in many respects. He came of a family famous for great stature and physical strength. He was 6 ft. 2 in. in height, and as a young man his feats of wrestling and weight-lifting were known far and wide. His gigantic strength and endurance were to be put to a severe test in later years.

His first mechanical productions consisted mainly of improvements to the pumping engines then in use in the Cornish mines. At that time many Cornish engineers were endeavouring to produce better stationary engines, but they were hampered all the time by the difficulty of avoiding infringements of Watt's patents regarding the condensing engine. Trevithick, with characteristic boldness, decided to dispense with condensation altogether and to compensate for the resulting loss by using steam at high pressure. It is interesting to remember that Watt himself had experimented with high-pressure steam and actually included its use in a patent of 1769. Later, however, he consistently opposed its introduction on the ground that there was risk of explosion. Not content with this, he and Boulton subsequently tried to get an Act of Parliament passed to prevent the construction of any more engines on the high-pressure principle. Fortunately for the progress of the steam engine this attempt failed.



Back view of the house, showing out-buildings and the extent of the small garden

After producing a number of successful pumping engines Trevithick turned his attention to the application of steam to locomotion, and he produced a steam carriage that ran successful trials on the road at Camborne in 1801, and was said to have attained a speed of from four to nine miles per hour. After further experiments with road vehicles his thoughts began to turn in the direction of the railway, which afforded a smooth iron track in place of the rough surface of the road. He set to work to produce a railway locomotive, and by 1804 he had this actually at work on a railway at Pen-y-Darran, in South Wales. This was the first steam locomotive to run on a railway, and it is of particular interest in that Trevithick discharged the steam up the chimney, and did so deliberately because he had found that the result was

to increase the draught. If any one man can be regarded as the inventor of the railway locomotive it is Trevithick, and there can be little doubt that he was also the inventor of the steam blast, which was used later by George Stephenson with such great effect in his locomotives.

In 1803 Trevithick applied his engine successfully to driving rock drills and three years later he entered into a contract with the Trinity Board for dredging in the Thames. For the latter purpose he constructed steam dredging machines of the chain-and-bucket type. In 1809 he was engaged upon the first and unsuccessful attempt to bore a tunnel beneath the Thames, and when this scheme was abandoned he devoted his attention for some time to various schemes for the propulsion of ships.

Subsequently he constructed a steam threshing machine and followed this by a steam plough. It is interesting to note that in 1812 he wrote a letter to the Board of Agriculture stating his belief that every branch of agriculture could be carried out by steam power, and that such a use of the steam engine would "double the population of the kingdom and make our markets the cheapest in the world."

In 1814 Trevithick became interested in a scheme for operating mines in Peru. He constructed nine pumping engines and shipped them to Lima, where they proved so successful that a couple of years later he set out for Peru taking with him additional engines. He was received with the wildest enthusiasm at Lima and it was actually proposed to erect to him a statue in solid silver! Then the War of Independence broke out, Trevithick's engine houses and pumping machines were smashed up, and he barely escaped with his life. After a terrible journey across country he arrived at Cartagena, exhausted and penniless. There he met, of all unexpected people, Robert Stephenson, who was on his way home to England at the termination of an engagement as a mining engineer on the eastern slopes of the Andes. "Is that Bobbie?" asked Trevithick, "I have nursed him many a time." Stephenson lent Trevithick sufficient money to enable him to return home to Cornwall.

Richard Trevithick

The story of Trevithick's later years is very sad. In spite of the great value of many of his inventions, these had brought him little or no profit, and his petition to Parliament for some reward for them was unsuccessful. Later on he made attempts to induce the Admiralty to grant him facilities for demonstrating certain improvements in methods of steam navigation, but this endeavour also failed. He died in poverty on 22nd April, 1833, at the age of 62, without having succeeded in bringing about the general introduction of any of his inventions.

It is not difficult to understand why Trevithick failed. As an inventor pure and simple he was undoubtedly brilliant—too brilliant in fact, for his brain was incessantly reaching out to grapple with new problems. Having perfected an invention, he appeared to lose interest in it immediately in favour of some other invention, with the result that he never pressed anything forward to the stage of commercial success. His whole life, to use the words of Samuel Smiles, was "but a series of beginnings."

The Story of the Motor Car—

(*Continued from page* 581)

screw acts on the worm wheel with a sliding motion and, as the illustration makes quite clear, at least two teeth are always in contact over a large area, while the screwing-in motion carries oil to the place where it is required. The result is that silence and continuity are obtained. This type of drive is found on such cars as the Daimler and Lanchester, and it is largely used on heavy vehicles such as motor omnibuses. It is not so popular on the whole as the modern forms of bevel drive, chiefly because the phosphor bronze wheel is expensive to make.

The drive is taken from the large bevel or the worm wheel—either of which is described as the crown wheel—to the actual rear axle shafts through the mechanism known as the differential gear. This is contained in a casing known as the differential casing, in which the rear axle shafts are journalled centrally. It is to this casing that the crown wheel is fixed.

The necessity for employing differential gear has already been partly explained and its action must now be described more fully. On the inner ends of the two portions of the rear axle shaft bevel wheels are keyed, and these are in mesh with other bevel wheels carried on pins or short shafts fixed to the differential casing. The way in which these bevel wheels interact is clearly shown in the illustration of the differential gear of the Meccano Motor Chassis on page 581, while the illustration of the Daimler drive on the same page shows the end view of one of the shaft bevels in mesh with the two intermediate bevels.

When a car is travelling straight forward the casing turns with the crown wheel and carries with it the bevel wheels on the ends of the axle shafts. The connecting bevels do not rotate at all but are the links between the casing and the shaft bevels that cause the latter to rotate. Thus the whole of the differential gear rotates in one mass along with the crown wheel.

Now consider what happens when one wheel of the car is prevented from turning. The bevel on the shaft from this wheel will no longer be able to rotate and the connecting bevels will only be able to turn with the differential casing by rotating also, so that they run on the stationary shaft bevel. It is easy to see that the free shaft bevel is now subject to movement of two kinds. It is being pushed round by the rotation of the connecting bevels with the differential casing and it is also being turned by the rotation of the connecting bevels with which it is in mesh. The result is that it actually rotates at double speed.

This extreme state of affairs is, of course, seldom realised in practice, although it may be produced by jacking up one of the rear wheels. But, as already explained, in turning corners a reduction in speed of the inner wheel as compared with the outer wheel is necessary. The differential enables this to take place easily, the outer wheel being automatically speeded up sufficiently to compensate for the loss of speed of the inner wheel.

A very puzzling experiment may be made with a car incorporating differential gear of this kind in the rear axle. If both rear wheels are jacked up clear of the ground, and one is turned by hand, the other will also revolve, but in the opposite direction. It is easy to see how this comes about by following the directions of rotation of the bevel wheels that intervene between the two road wheels, but the effect of the experiment is a little startling to those who know nothing of the mechanism of a car. It is said that in one case an owner of a car who discovered that his car behaved in this manner was firmly persuaded that something was wrong and took the vehicle back to the makers to have it put right.

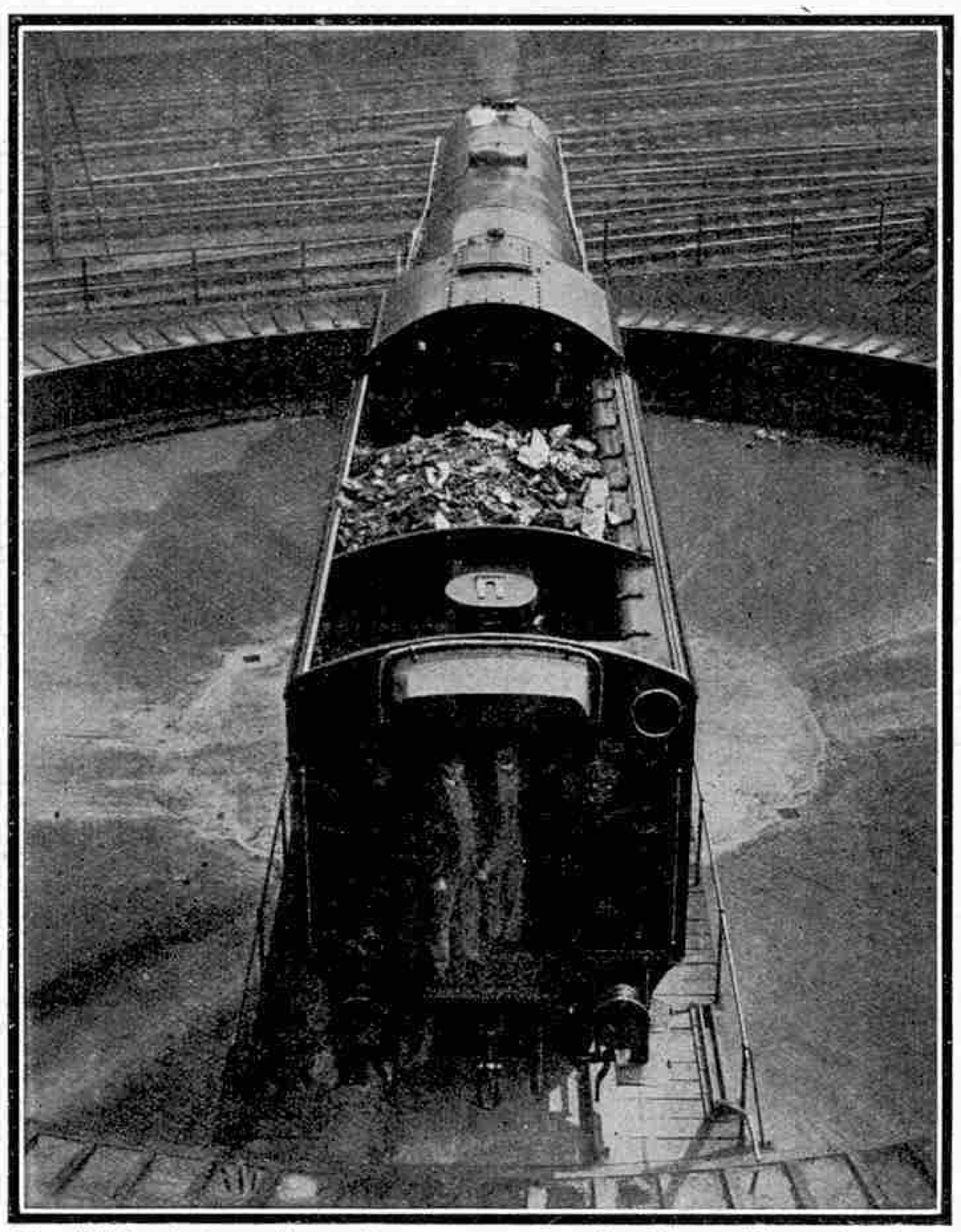
Evolution of the Locomotive Tender

King's Cross to Edinburgh Non-Stop

By J. R. Hind

A CENTURY ago the driver of a locomotive engine was provided with a seat on the top of the engine boiler, from which he had a good look-out but which must have been a decidedly uncomfortable position. His fireman stood on a truck that was linked up with the engine by means of a chain, and it cannot have been an easy matter to swing coal into the firebox as it swayed about in front of him. The evolution of the modern locomotive engine tender from that time to the present is very interesting.

In the designs of Richard Trevithick's Pen-y-darran locomotive that was built near Merthyr Tydfil in 1804, no tender of any kind was provided. In the first locomotive that was used with financially successful results—the Blenkinsop engine with the rack rails, patented by John Blenkinsop in Leeds in 1811—the fuel was carried on a platform between the frame beams at the end of which the fireman stood, so that no tender was required.



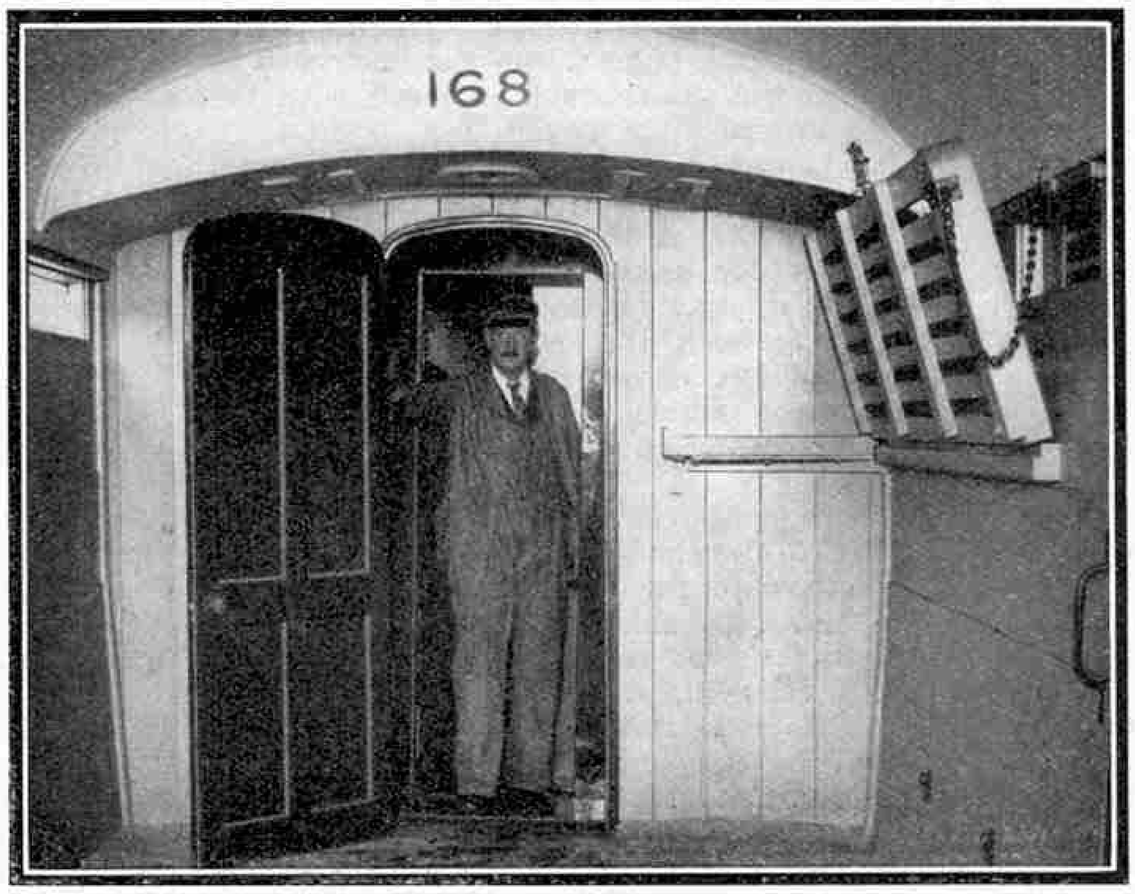
The "Flying Scotsman" seen from an unusual angle. The corridor passing along the right-hand side of the tender is clearly shown and also the exit at the rear of the tender communicating with the front brake van

The tender did not make its appearance until 1813, when William Hedley, the Northumbrian experimenter, made his famous engines *"Puffing Billy"* and *"Wylam Dilly"* at Wylam Colliery. The tender then provided consisted of a wooden frame supported on four wheels. It carried a square water tank and a coalbox, and its total weight when fully loaded was about four tons. This tender was not attached behind the engine but was pushed in front of it, as the firebox was alongside the funnel.

When the first locomotive works in the world were started at Forth Street, Newcastle, by George Stephenson, Robert Stephenson, Edward Pease and Michael Longridge, *"Locomotion No. 1"* of the Stockton and Darlington Railway was constructed to haul the world's first railway train. This engine was provided with a tender built of timber and carried on four cast iron wheels without any springs. Its coal capacity was 15 cwt., and it was fitted with an iron tank containing 240 gallons of water. In addition, the tender acted as a platform for the fireman. Later, at the Rainhill trials, the *"Rocket"* had a tender weighing $7\frac{3}{4}$ tons. This was mounted on four wheels and provided with a barrel in which water was stored.

By this time the position of the driver had been definitely located on a shelf at the rear of the engine, and throughout subsequent locomotive development the footplate has gradually evolved.

One of the earliest locomotives to be equipped with a tender on the lines of those now in regular use was the Bury Locomotive that was specially built in the year 1846 for the Midland Counties Railway.



The engine driver entering the brake van from the tender

At that time the water scoop had not been invented, and it was not until 1860 that John Ramsbottom, then Chief Mechanical Engineer of the London and North Western Railway, introduced the water trough and pick-up system. This example was not followed by any other railway company until 25 years later, when the Lancashire and Yorkshire Railway put down their first installation. To-day practically all the main routes in this country—except on the Southern Railway—have been equipped with these troughs, enabling engines to make long non-stop runs.

The troughs are about a quarter of a mile in length, placed on level stretches of the line in positions where there is an ample supply of water of a suitable quality for boiler use. The tender carries beneath it a scoop connected with a pipe leading to the top of the water tank, and when a trough is reached this scoop is lowered by hand or by compressed air so that it dips some 2 in. into the water. Provided that a train is travelling at not less than 20 miles an hour, its movement causes water to rush up the pipe and into the tank. Subsequently the trough fills itself again automatically.

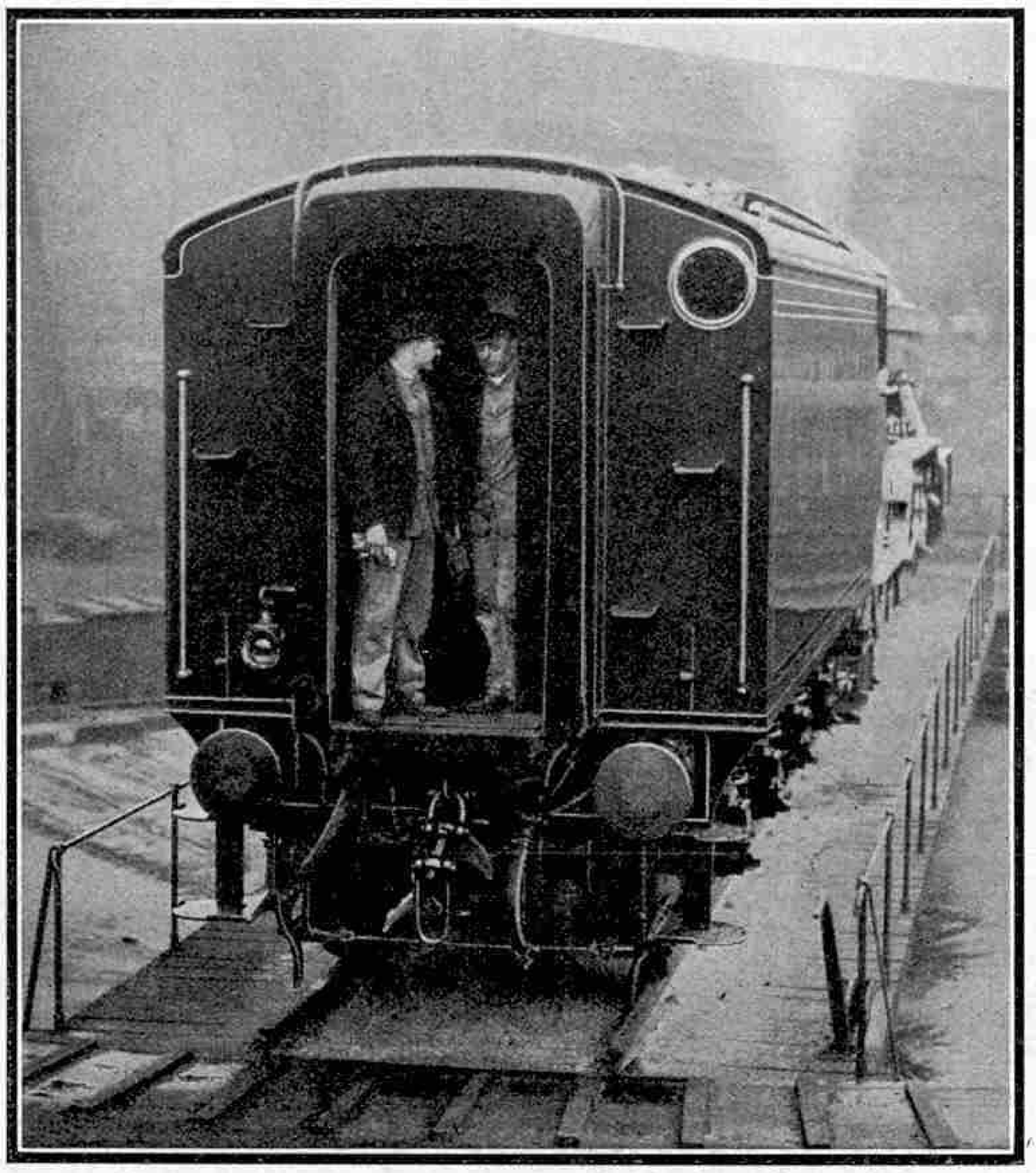
Generally speaking, the development of the engine tender in modern times has been in the direction of increased capacity for coal rather than for water. As we have seen, the water tanks can be replenished en route, but it is essential that the whole supply of coal for a long-distance run should be on board before starting.

In the case of the new L.N.E.R. "Pacific" locomotives the tender is large enough to carry supplies of fuel sufficient for the longest non-stop run that the locomotive would ever be likely to be called upon to make. The endurance of the engine crew has its limits, however, and these were reached when the 268-mile run from London to Newcastle was covered without any intermediate stop, last year. The run from King's Cross to York and back is almost invariably done on one filling of coal but in this case the crew are allowed ample time for a rest at York before they have to mount the footplate for the return journey.

As was proved by the L.M.S. in their *"Royal Scot"* runs, sufficient coal can be carried for a journey even further than from London to Carlisle, which is 299¼ miles. This train recently ran non-stop from Euston to Edinburgh and the down train from Edinburgh to Euston, but the strain on the enginemen is far too great to justify a run of this length being performed daily.

The L.N.E.R. have made a great step forward in this direction to enable them to run their non-stop expresses between King's Cross and Edinburgh, a distance of 392·7 miles in each direction, and certainly a world's record so far as publicly scheduled trains are concerned.

Two Gresley "Pacifics," Nos. 4472 *"Flying Scotsman"* and 4476 *"Royal Lancer,"* have been provided with new tenders fitted with corridors along one side and flexible connections for attachment to the train proper. The corridor enables the driver and fireman to leave the footplate and pass along, through the forward brake van, into the first third-class compartment of the train. In this manner the driver and fireman who are in charge of the train from King's Cross are relieved when they have run 197½ miles and are passing Tollerton, approximately the halfway point of the journey.



Another view of the exit at the rear of the tender. Note the circular window providing light along the corridor

The corridor in the tender is located at the right-hand side looking forward, and is 18 in. in width and 5 ft. in height. Lighting is provided for by circular windows at each end of the corridor. Beneath the empty space along this side of the tender a weight has been placed in order to counteract lack of balance and so prevent any unsteadiness. The tender is of the usual 8-wheeled type with rigid axles and weighs 62 tons 8 cwt. in working order. The new coal capacity is nine tons, instead of eight as in the case of the ordinary 56·5-ton standard "Pacific" tender. Eight other "Pacifics" are to be fitted with similar tenders.

Can You Solve These?

Puzzle No. 1. *Contributed by W. Balfour, Glasgow.*

Brown, a motor-cyclist, starts to ride from London to York at exactly the same time as Black, another motor-cyclist, starts from York to ride to London. Brown's machine can only do 35 m.p.h., while Black can travel at 50 m.p.h. The distance between the two cities is, say, 200 miles and, assuming that each travels at his maximum speed, which will be nearer London when they meet?

* * * *

Puzzle No. 2. *Contributed by J. Simpson, Halifax.*

A hole had been made, 9 in. in length and 2 in. in depth, in a door and a joiner was set to mend it. He had only a piece of wood 6 in. in length by 3 in. in width with which to repair the damage, but after a good deal of thought he cut the plank into two pieces and carried out his work. How did he cut the plank?

* * * *

Puzzle No. 3. *Contributed by C. M. Beattie, Lewes.*

In each hole of a Meccano flat plate, 2½" square, insert one of the numbers 1 to 25 so that the vertical, horizontal and diagonal rows each add up to 65. Each of the numbers 1 to 25 must be used.

Answers to Last Month's Puzzles

No. 1. Scarlet Hand. This is revealed by removing the first three and the last three words. The initial letters of the remaining portion of the message reveal the answer.

* * * *

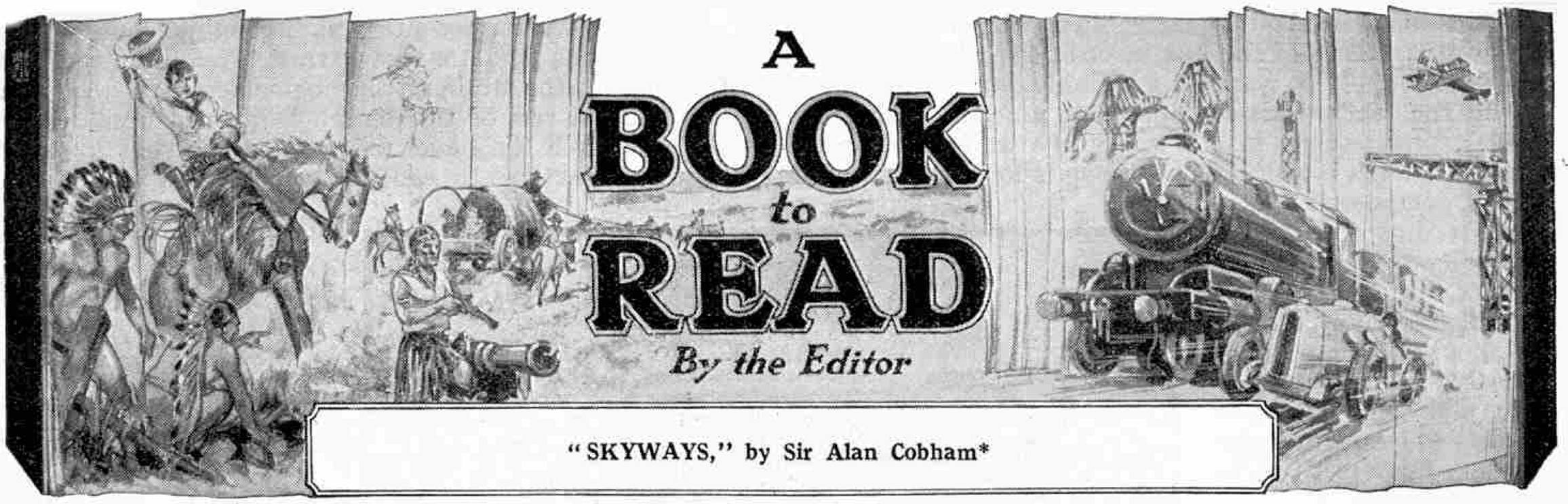
No 2. The weights of the four pieces were 1, 3, 9 and 27 lb. respectively.

* * * *

No. 3. The coal merchant was quite correct, for the level of the scales was precisely that of the ground in which they were embedded. Had the scales been either slightly above or slightly below the ground level the greater portion of the weight would have rested either on the wheels not being weighed or the wheels being weighed, according to whether the scales were above or below the ground.

* * * *

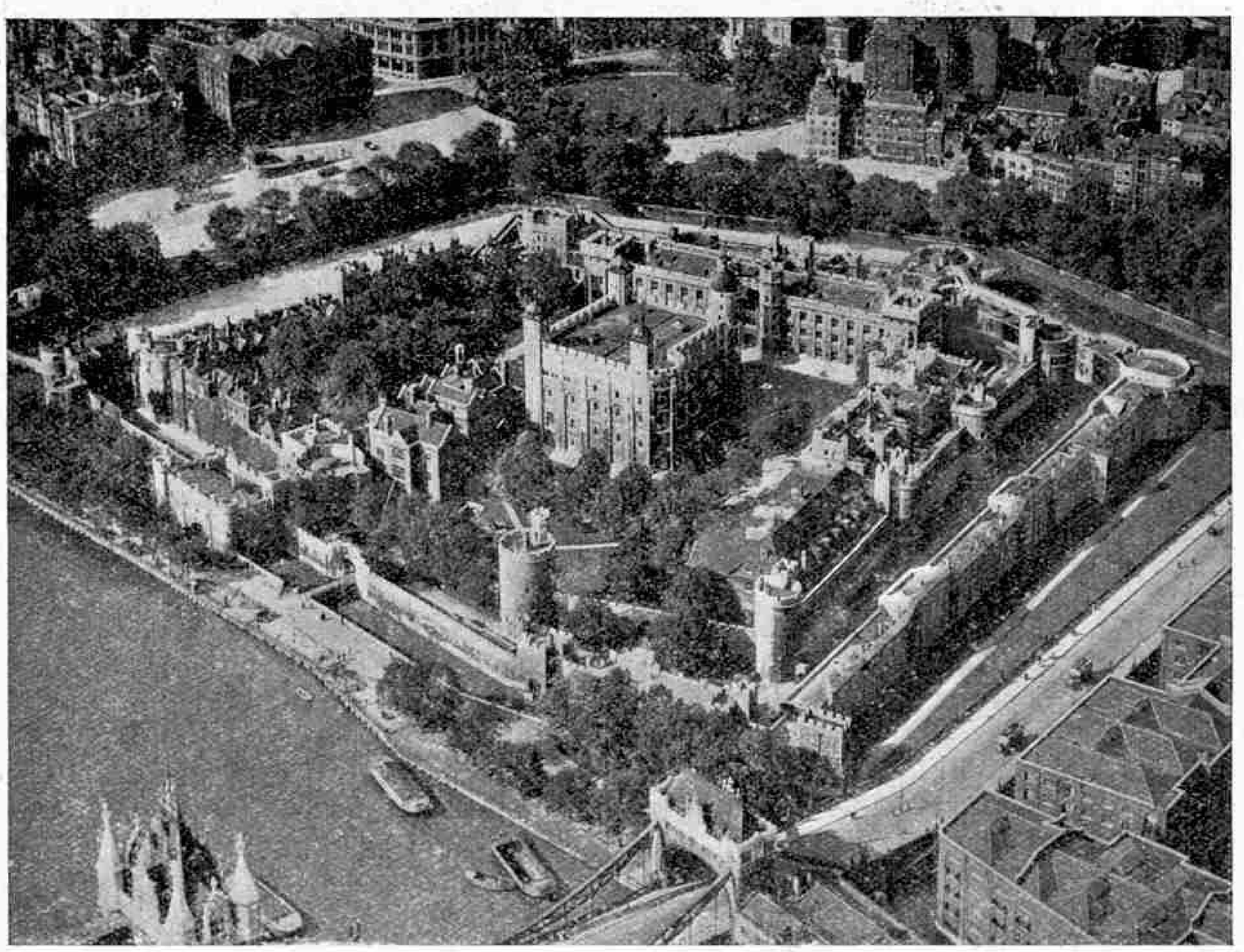
No. 4. A chair.



"SKYWAYS," by Sir Alan Cobham*

HERE is a fine book in which our foremost British airman, who has done most to develop civil and commercial flying, tells the story of his early adventures.

Sir Alan's interest in air matters started very early in life, for while still a boy he built a man-power machine with which he hoped to compete for a large prize offered in Paris. His partner in the effort assured him that by pedalling hard he could work up at least 3½ h.p., which would have given sufficient flying speed; but something must have gone wrong with the calculations for the machine never left the ground. This was very disappointing to the boy, but a distinct relief to his family who, as he tells us, were consumed with anxiety for the fate of the would-be aviators when they should find themselves "hundreds of feet in the air!"



A fine view of the Tower of London from the Air

On the outbreak of war Sir Alan joined the Artillery, and in September 1914 found himself on the Aisne. During that year he saw little flying, but in 1915 and subsequently aeroplanes appeared day after day in steadily increasing numbers; and so day by day the old desire to fly became stronger. He had some difficulty in obtaining a transfer to the R.F.C., but eventually succeeded and commenced his training. It appears as though nature intended Sir Alan to be an airman for, as he tells us, "I took to flying like a duck to water, with the result that I was made an instructor three weeks after I started to fly."

After the Armistice Sir Alan's great object was to make a start in civil aviation. He expected to have some difficulty in obtaining an appointment with an aviation company, but he did not realise what he was up against until he discovered that there were some 22,000 pilots to be demobilised and about 22 civil pilot's jobs vacant! After meeting with many rebuffs and disappointments he at last came across two brothers who were in a similar predicament to himself, and they agreed to go into partnership under the name of the Berkshire Aviation Company. The company was valued at £900 and this sum was arrived at as follows: One aeroplane—Avro 504K, value £450; One Ford car, value £200; Petrol, value £50; Cash, £200. The whole of this little lot, with the exception of between £300 and £400, had been obtained, the author cheerfully tells us, with borrowed money!

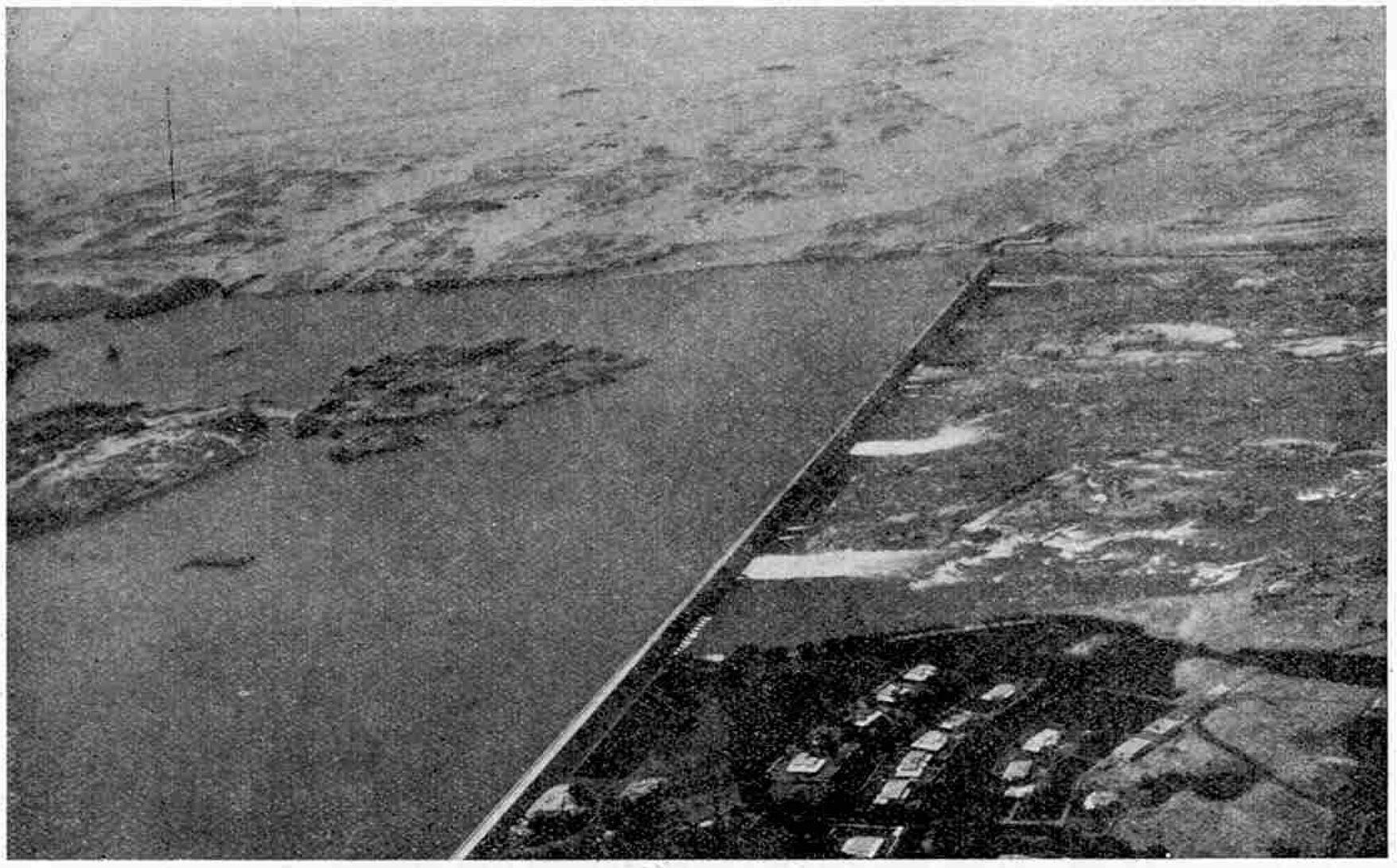
Many interesting and happy months followed, during which Sir Alan acted as pilot to the company, giving flying exhibitions and passenger flights in various parts of the country. His many amusing experiences during this period make a good story that the author tells in a delightful fashion. On one occasion he had as a passenger an auctioneer weighing 17 stones, who became so firmly wedged in the machine that he was only extricated by brute force after expelling all the air from his lungs to make himself a little thinner! Then there were dozens of people who confidently gave such instructions as to "fly over the house on the right by the market as father is looking out to wave!" One must not forget also the lively old lady who jumped lightly out of her seat at the end of a flight and put both her

*Nisbet & Co. Ltd. 15/- net.

feet through the fabric of one of the planes!

The next work to which Sir Alan turned his attention was aerial photography, his first ambition being to be the first to photograph Snowdon from the air. Work of this nature eventually led to his association with the De Havilland company, which lasted for some years with great benefit to both.

It was about this time that the possibilities of the air "taxi" were first realised, and the De Havilland company turned their attention to the hiring of aeroplanes for various purposes in addition to photography. On one of his first taxi jobs Cobham rushed an American to Cherbourg in a successful attempt to catch a boat for New York that left Southampton only half an hour after the American, in London, had discovered that his immediate departure was necessary. Many exciting episodes followed and the exploits of the author while piloting special machines make excellent reading.



A photograph by the Author of the Nile Dam at Assouan

The journeys took the pilots very far afield. Sir Alan himself flew to Ireland, Spain, Germany, Scandinavia, Italy and Serbia. Belgrade was visited on behalf of an English newspaper in order to bring back photographs of a royal wedding at the earliest possible moment, and Sir Alan stole a march on the pilots working for other papers by parking his machine within a mile or two of the centre of Belgrade, instead of at the nearest aerodrome which was 60 miles away.

Newspaper work provided many opportunities for air pilots and one particularly good story deals with the days of the last outbreak of strife in Dublin. Four aeroplanes in quick succession were hired from the De Havilland organisation by various newspapers to proceed to Dublin to bring back special reports and photographs. None of the pilots had any notion that the others were engaged on the same trip until all descended on the aerodrome at Shotwick to fill up with oil and petrol before crossing the Irish Sea. When they found that they were all making for the same destination they flew in formation, and were mistaken by the populace of Dublin for R.A.F. bombing machines, sent over to assist in quelling the riots!

On this occasion Sir Alan represented "*The Times.*" He duly obtained his photographs and had already got his machine on the move when he observed frantic signalling from one of the hangars, the object of which presumably was to prevent his leaving. Turning a blind eye to these signals he made off—the only one of the four airmen to leave for England. In due course he arrived at Shotwick, where he learned that a furious storm that was then raging south of Birmingham would prevent him from completing his flight. At this moment a car that had been provided by a rival newspaper made its appearance and Sir Alan succeeded in persuading the driver to take him to Chester Station, and the journey was finally completed by special train from Crewe. As a result of Sir Alan's initiative "*The Times*" appeared next morning—or rather the same morning, for it was 3.30 a.m. when he arrived at Euston—with exclusive pictures of events in Dublin.

Besides many journeys of this type Sir Alan made others in connection with the distribution of films of sporting events such as the Derby and the Grand National, for showing in distant parts of the country on the same day. His most important flights were made with private passengers, however, and it was chiefly on these trips that he gained his wide experience of flying in varying conditions in all countries of Europe, and also in Morocco and Algeria, and eventually in Egypt and Palestine.

He and his machine were ready for any flight at the shortest notice. When trouble appeared imminent in Bulgaria an American newspaper engaged him to take a correspondent to Sofia. This correspondent coolly remarked before starting that nothing but bad luck would attend them as he himself was a perfect Jonah. He was right. Several forced landings were necessary on the outward journey owing to bad weather; the whole trip was rendered superfluous by the enterprise of another correspondent of the same newspaper; and on making what they thought to be a secret landing at Sofia, the pilot and his passenger were greeted by a party of English-speaking officers who had been expecting them for the past three days! Finally the under-carriage of the machine collapsed at Strasbourg on the return journey!

It is interesting to note that while staying at Strasbourg Sir Alan found that he was unable to look down from the height of the spire of the famous cathedral without feeling dizzy, although he had never experienced any such feeling in an aeroplane even at far greater heights, throughout the whole of his career.

(*Continued on page* 561)

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Gold Mining on a Small Scale

In the more out of the way spots of Rhodesia are dotted about everywhere tiny but flourishing gold mines. The simple working of these can easily be explained in a few words. If supposedly rich gold ore is discovered, a sample is tested. The ore is crushed in a pestle and mortar, and the dust is placed in a pan and washed. As gold is very nearly the heaviest metal in existence, what there is in the sample stays behind when the pan is tipped, forming a " tail," which in some cases extends half way round the pan, though this would be a particularly rich panning.

If a satisfactory result is obtained a shaft is sunk, and blasting in the evening followed by native labour during the daytime soon brings forth a few tons of ore. This is brought to the surface by means of a windlass and bucket and deposited in a dump, whence it is carried to the sorting tables in tins and shovels. There a native or a white man separates the useless stone or " schist " from the likely ore. The latter is conveyed by wheel-barrows to the tiny three-stamp " dolly " mill, and deposited in the container bin which, when full, holds exactly one ton of ore. A native picannin shovels it out of the bottom and feeds the mill from the back.

Separating gold-containing ore from useless schist

In the machine three heavy stamps, weighing 145 lb. each, pound the stone to dust, and water turns this to mud and washes it through a sieve. Just below is a steel lip, which is covered with a thin layer of mercury, and as the muddy water is washed over this the gold sticks to the mercury, forming an amalgam. Any gold that escapes is caught on a mercurified plate below the lip. At many mines coconut matting is spread below the plate so that if by chance the gold escapes both the lip and the plate, which is a rare occurrence, it is bound to be caught by the matting.

The day's run is usually from 5.30 a.m. to 5.30 p.m. with a break of one hour at mid-day. About 1½ tons of ore goes through the mill in that time, and when the day is over the result of much toil and expenditure is reaped. The amalgam is scraped off the lip and plate with a hard piece of flat rubber or steel, and put into a square of chamois leather. The coconut blankets are carefully washed in a bucket and the mud poured into a pan, where it is washed again and mercury poured in to form the amalgam. This then joins the rest in the chamois leather.

Now comes the longed-for moment! As much mercury as possible is squeezed out in a silver shower through the leather, leaving behind it a silvery-yellow ball. There are now equal quantities of gold and mercury in this amalgam. Let us suppose we have had a lucky day and obtained four ounces of amalgam; then the two ounces of gold are worth about £8 when taken to the Assay Department. But that would be an excellent day's run. Sometimes barely half an ounce of amalgam is realised, and the gold in that is hardly worth enough to pay for the native labour or paraffin to run the oil-engine. On the other hand, as much as £15 or £20 may be taken in a day from a particularly rich pocket. It is a hazardous game. You either win or lose, and men who are absolutely penniless one month may be literally rolling in wealth the next.

NIGEL DENNIS
(Bulawayo, S. Rhodesia).

The Fireman's Helmet

The distinctive helmet worn by firemen has a showy appearance, but the construction of every part of it has been carefully thought out from an entirely practical standpoint. The designer of the type used by London firemen was at one time Chief of the L.C.C. Fire Brigade, and incorporated in it the best points of practically every type of fire-helmet in the world, which he toured to gain the necessary information.

The helmet is built up from several pieces that may be replaced separately if damaged. These include the comb, the sides, the front peak and back curtain (or peak), the chinguard and the lining. The pieces are fastened by lap-joints, screws and rivets, no soldered joints being used owing to the possibility of exposure to high temperature.

The lining consists of a rubber band round the inside of the helmet. Thus it protects the fire-fighter from electrical as well as from mechanical shocks.

The brass comb is the most impressive and important part of the helmet. It is hollow but very strong, and in the front are holes for ventilation. The front view of a helmet is much the shape of an inverted " V " with the apex slightly flattened. When a falling object such as a brick or a burning piece of wood descends on the helmet, the comb withstands the blow and the peculiar shape causes the material to slide off. Contrary to their appearance, the sides of the helmet, although strong, are very flexible; bulging up to half-an-inch under the pressure of a thumb.

The front peak's chief purpose is to protect the eyes, but another very useful end is secured. When a fireman falls down unconscious, the overhanging part of the comb and the peak both touch the ground and keep the fireman's mouth from it, and so lessen greatly the risk of suffocation. The back peak prevents molten metal, etc., from falling on the neck.

The spaces between the two peaks on either side of the helmet are filled by rosettes which protect the ears, but do not affect the hearing. Attached to the rosettes are the ends of the leather chin guard. This is protected by overlapping brass rings. This completes a very efficient fire-fighting appliance that is by no means the "heavyweight" it looks.

E. T. BRYANT (Hornsey, N.8).

Building Material made from Sugar Cane

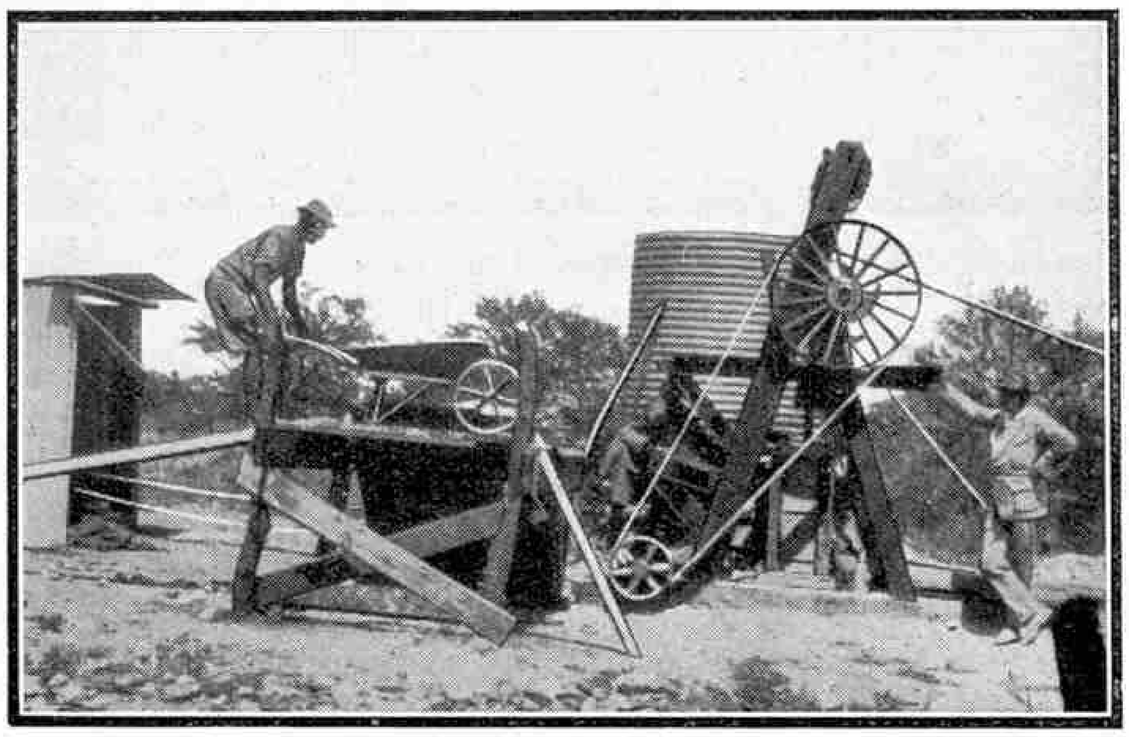
It is now often possible to use up material that was formerly thrown away as useless. One material of this kind is bagasse, or the fibre left after the syrupy juice has been crushed out of the sugar cane, which is now made into boards.

After emerging from the giant presses in the sugar mill the bagasse is first boiled in a large vat to make it soft and to boil out any remaining juices. When it has become soft enough it is put into a powerful press and squeezed into the shape of a flat board. This is fed straight into a long drying machine 800 ft. in length, where it is heated to 350°F., after which it is cut into convenient lengths and sizes.

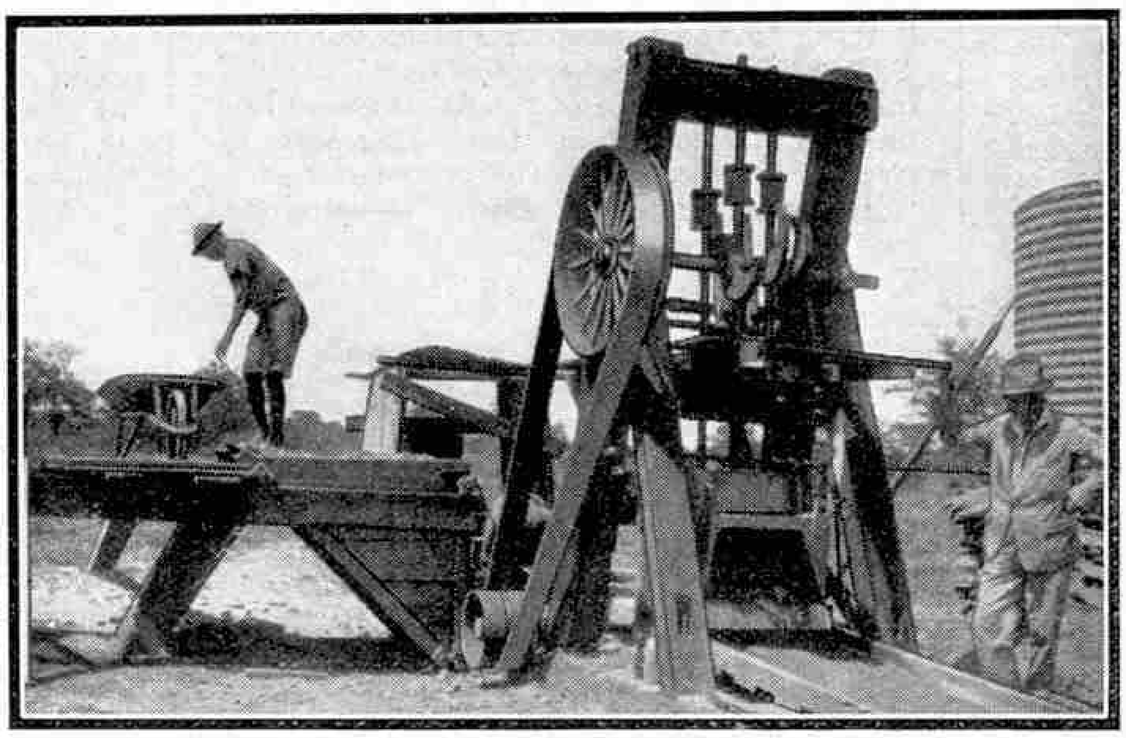
The boards thus made are very strong indeed, as the fibres of which they are composed have countless little hooks that interlock when pressed together. The fibres also contain millions of minute air cells, and in consequence the boards offer considerable resistance to the passage of heat. The interiors of buildings made of this board are not as cold in winter nor as hot in summer as those made of ordinary wood, and even thin strips placed under the roof make the upper rooms of a house much warmer. A very important use for the material is in the construction of refrigerating chambers. It is very easy to use, as it contains no knots or cross grains similar to those that make wood difficult to work, and pieces of almost any size may be obtained.

A still more striking instance of the use of products formerly wasted is the case of straw and husks, from which no fewer than 217 different articles can now be made.

W. E. WARNER (Brentford).



Rhodesian native taking gold ore to the stamping mill



Crushing gold ore. Three-stamp "Dolly" mill at work

River Dredging by Compressed Air

The River Avon in the South Island of New Zealand is a shallow and winding river. At Christchurch it is from 40 ft. to 50 ft. in width and normally from 9 in. to 2 ft. only in depth. There its banks are covered with well-kept lawns and shaded with stately weeping willows. In fine weather dozens of people go out on the Avon; boats may be hired quite cheaply from the sheds scattered along its banks, and in order to keep it open for these pleasure boats some dredging is necessary.

The ordinary methods of dredging are quite unsuitable, owing to the natural shallowness of the water and to the fact that the mud could not be dumped on the lawn banks, while to take it to sea in pontoons would prove expensive. This difficulty was overcome by an ingenious scheme suggested by a Dunedin engineer.

He built a pontoon raft on which he placed an internal combustion engine that drove an air compressor. When it is desired to dredge, adjustable pipes are lowered until they are immediately above the bed of the river, and the engine is then started. Compressed air forced through the pipes disturbs the mud and silt and separates it into small particles that are carried away by the current. The raft is worked across the river and down stream by a rope and winch. The dredging does not alter the water level, as many springs which were previously blocked by the mud are released.

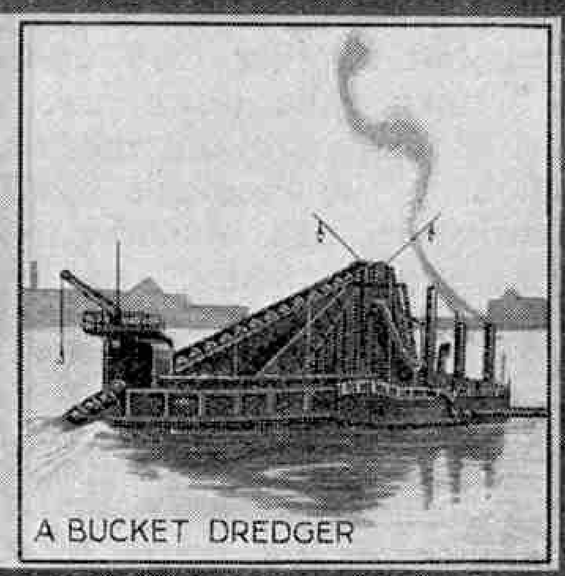
H. Fox (Christchurch, N.Z.)

A Queensland Cyclone

One Sunday night in January, a severe cyclone started at my home in Queensland and before morning the wind had reached a velocity of 90 miles an hour. By Tuesday noon it was calm once more, and my father went to the help of a neighbour, whose house blocks at the front had given way, dropping the front verandah to the ground and leaving the kitchen in mid-air. Suddenly the wind and rain returned, and from our neighbour's house my father had a splendid view of the roof of his dining room and workroom, rafters included, flying through the air. The wind kept going until Wednesday afternoon, but the rain continued until by the end of the week we had had 8 ft. of it and the river had risen 60 ft. Finally there came a tidal wave, a wall of water about four feet in height that rushed up the river and swept away what the cyclone had left.

G. MCCUBBEN (Mackay, Queensland).

ENGINEERING NEWS



New Tunnel through the Cascade Range, U.S.A.

The cutting of the Cascade tunnel of the Great Northern Railway, U.S.A., was recently completed, the two engineering gangs meeting in the heart of the mountains. This tunnel cuts through the Cascade Range, which lies between the Rocky Mountains and the Pacific Coast, and in places rises to well over 10,000 ft. in height. The tunnel cuts through the range between Berne and Scenic, Washington, and when open for traffic will shorten the railway route over the mountains by 10 miles. At present the railway winds and twists along 35 miles of track, but the new route offers 25 miles of perfectly straight line over very considerably easier gradients.

* * * *

Anchoring Steel Towers Carrying Transmission Lines

The engineers who are supervising the Central Scotland Electricity Scheme have recently conducted a series of experiments with "Malone" anchors to support the steel towers bearing the transmission lines. In fixing anchors of this type, four holes, each approximately 5 in. in diameter, are bored in the earth to a depth of 10 ft. A charge of dynamite is then lowered to the bottom of the hole and exploded, with the result that a cavity about 2 ft. square is formed. The anchor is then lowered into the cavity and the bore-hole is filled up with mortar. It is stated that this method of guying the transmission towers will reduce the cost of erecting overhead lines very considerably.

* * * *

Steam-Driven Passenger Omnibus

For the past year a steam-driven omnibus accommodating 61 passengers has been operated by the Detroit Motorbus Company. The 'bus has already travelled over 28,000 miles under service conditions and has given absolute satisfaction.

The propulsion plant consists of a high-pressure flash-type boiler, a burner operating with either fuel oil or petrol, a system of automatic controls and a four-cylinder cross-compound engine. There are also four boiler-feed pumps, two vacuum pumps, lubricator and electric generator. The water is passed through an exhaust steam condensor and is used over again for steam making purposes.

* * * *

A new ribbon loom has recently been manufactured by a Swiss firm. This new machine possesses a great advantage over the existing type as its output is double the usual amount obtained, four rows of shuttles being substituted for the usual two rows.

High Pressure Steam Plant

The American Gas and Electric Company, in conjunction with the United Gas Improvement Company, have recently constructed a new electricity generating station at Deepwater, N.J. Four standard and two reheat boilers have been installed to generate steam at 1,350 lb. per sq. in.

Steam at the rate of 331,000 lb. per hour at a temperature of 725°F. will be produced by the standard boilers, using a steaming economiser and air preheater, while the reheat boilers will be capable of delivering 290,000 lb. of steam per hour, and reheating 419,000 lb. of steam to 775°F. The generating plant of the station will have an initial capacity of 118,500 Kw. and the turbines will be operated by steam at a pressure of 1,200 lb. per sq. in.

* * * *

World's Largest "Cabin" Liner

It has recently been stated in the daily press that the largest "cabin" steamer afloat is the "*Duchess of Bedford*" belonging to the Canadian Pacific Railway. This statement is incorrect as four "cabin" liners in the service of the White Star line are all larger than the "*Duchess of Bedford*," two of these vessels—the "*Adriatic*" and the "*Baltic*"—being the two largest "cabin" liners in the world. The remaining liners are the "*Cedric*" and the "*Celtic*."

The tonnages of the five vessels mentioned are as follows:—"*Adriatic*," 24,563 tons; "*Baltic*," 23,884 tons; "*Cedric*," 21,227 tons; "*Celtic*," 21,179 tons; "*Duchess of Bedford*," 21,100 tons.

* * * *

Australia's Wireless Users

According to the latest figures available, it is estimated that in Australia there are approximately 300,000 wireless receiving sets in use. The revenue obtained from the issuing of licenses must be at least £360,000 per annum. Half the total number of sets in operation are in use in Victoria.

A scheme is on foot to establish a number of relay stations all over the country in order to enable "listeners-in" in the bush to hear the same programmes as the wireless enthusiasts in the towns.

* * * *

Electrically-Driven Cargo Ship

The use of electricity on sea-going vessels has until very recently been confined to such services as lighting, heating, hoisting of cargo, etc. The International Mercantile Marine Co. have now a vessel that makes use of electricity for motive power. This vessel is the cargo ship "*California*" plying between New York and the Pacific Coast.

The electricity for the purpose of driving the ship's two electric motors is supplied by two generators that are actuated by turbines. An electric motor is directly connected to each propeller shaft, thereby doing away with the necessity for a reversing turbine.

The "*California*" is 601 ft. in overall length, and displaces 32,450 tons. Her gross tonnage is 22,000 and she has a capacity for 8,000 tons of cargo and 750 passengers. She has a maximum speed of 22 knots and her owners claim that she is the largest electrically driven liner in the world.

* * * *

Latest American Mail Steamer

The New Orient Liner "*Orford*" has recently been subjected to her trials and according to the reports at hand everything was successfully completed. Before she takes up her regular Australian mail service, the "*Orford*" is to make a number of pleasure cruises to the Mediterranean and to various of the Northern Capitals.

The "*Orford*" is a geared-turbine two-class cabin liner and has an overall length of 658 ft. She is 75 ft. in breadth, has a load displacement of 26,000 tons, and a gross tonnage of 20,000. The liner has accommodation for about 520 first class and 1,160 third class cabin passengers.

* * * *

Will the "*Majestic*" be Exceeded?

It is reported that in the near future both the White Star Line and the Cunard Company each intend to augment their fleet by another vessel. Plans have already been designed for the new White Star liner, and it is believed that the vessel is to exceed the "*Majestic*"—the World's largest liner—in size and performance capabilities. If the White Star Line eventually decide to carry out their project, it is very probable that the ship will be installed with heavy oil marine engines, and if this is the case, it will be the largest liner, and the largest oil-burning liner in the world.

Designs for the Cunard Company's projected leviathan have not yet been commenced, but there is every reason to believe that she will possess a faster turn of speed than their "*Mauretania*"—which is the present holder of the "blue riband" of the Atlantic.

In most cases the existing conveniences for the berthing of Atlantic liners will naturally be inadequate for the huge vessels of the future, and the New York Harbour Authorities are contemplating the advisability of increasing the size of their accommodation at an early date. It will be necessary for them to construct piers well over 1,000 ft. in length.

New Landing Stage at Tilbury

The Port of London Authority's new landing stage at Tilbury is now rapidly approaching completion, and the eastern section, which is 300 ft. in length and consists of eighteen 60-ft. pontoons, is already in regular use. It is held in position by seventy 170-ft. booms and has a total weight of approximately 700 tons. Two bridges connect the stage to the shore, where the road and rail approaches are being altered to facilitate the approach of pedestrians and vehicular traffic. The complete stage probably will be ready for use early next month.

* * *

The World's Fastest Cruiser

Until recently the honour of possessing the world's fastest cruiser has been claimed by the American Navy with the "*Omaha*," which has a recorded speed of 34.87 knots. This speed is exceeded, however, by two newly-commissioned French cruisers, the "*Duquesne*" and the "*Tourville*," which attained 35.3 knots and 36.15 knots respectively while on their trials. Each of these sister ships has a nominal displacement of 10,000 tons and is equipped with Rateau geared turbines developing 130,000 s.h.p. It is unlikely that the record set up by the "*Tourville*" will stand, however, as Italy has nearly completed a batch of cruisers that have a designed speed of 37 knots.

* * * *

The New "Rocket" Car

The "Rocket" car invented by a German, named Von Opel, has already achieved some remarkable results. On a recent occasion, piloted by Von Opel's son, it attained a speed of 170 miles per hour. In six seconds it accelerated to over 80 m.p.h., and at the end of 40 seconds it attained 125 m.p.h. The car is propelled on a rocket system but its construction so far is a secret. At first sight it does not appear to differ materially from an ordinary high-powered racing car, except at the rear, where a series of metal tubes emerge from a steel chamber having twelve circular openings. Each of these tubes contains a rocket that can be exploded by means of an electric spark. When a rocket is discharged the car shoots forward at a terrific speed and its momentum is maintained by exploding rockets at intervals.

The inventor states that the next car he constructs will be able to attain a speed of 205 m.p.h. and will be designed to run on a railway track as roads are unsuitable for such a high speed. He also contemplates the construction of a motor cycle to travel at 125 m.p.h., and an aeroplane to reach 600 m.p.h. in the upper strata of the earth's atmosphere. Not content with this, Herr Opel contemplates a time when rocket ships will be paying visits to the other planets!

A New High Explosive

The greatest single blasting operation ever attempted has been successfully carried out near Buxton, Derbyshire, 70,000 tons of stone being brought down. The occasion was the first on which selignite, a new high explosive, was used by the Buxton Lime Firms Company, at whose quarries the blasting took place.

A small chamber for the explosive was drilled in the base of the cliff, an electric fuse was attached and the passage was blocked up with concrete. Seven 70-ft. holes were drilled from the top of the cliff and selignite was placed in them. When the electrical contact was made the whole face of the cliff appeared to heave, and then 70,000 tons of stone hurtled to the bottom with a deafening roar. Some 5½ tons of gunpowder and selignite were used.

When cliffs are quarried in this manner stones do not shoot up into the air as is the case with the old method, when stones are sometimes sent flying half a mile, even in minor blasting operations.

* * * *

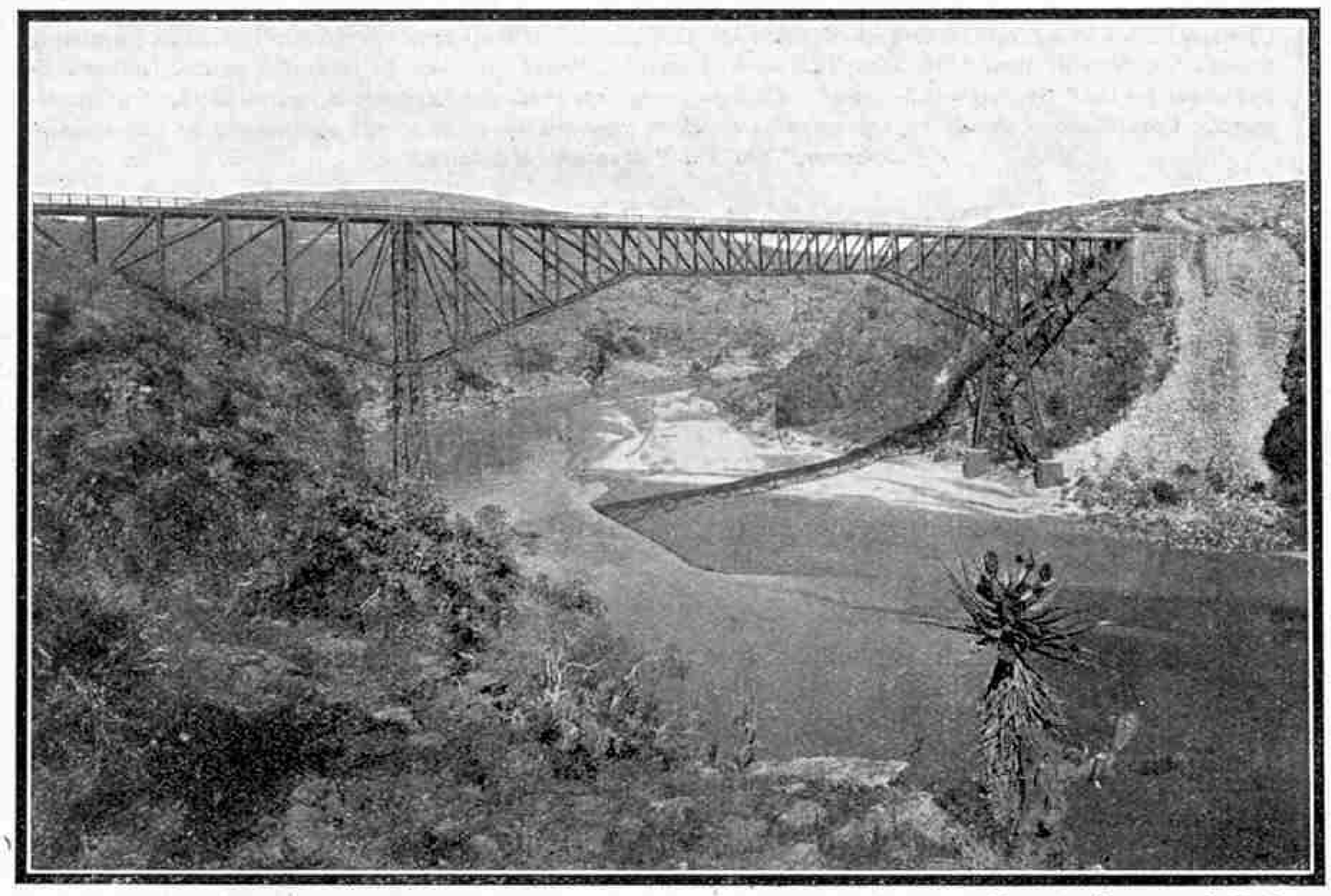
Petroleum Production in 1927

It is estimated that during 1927 the world's production of petroleum amounted to 1,252,000,000 barrels. Of the principal oil-producing countries the United States of America were responsible for 72.18 per cent. of this total; Russia produced 5.78 per cent.; Venezuela 5.14 per cent.; Mexico 5.13 per cent.; Persia 2.94 per cent. and Roumania 2.08 per cent.

* * * *

World Production of Aluminium

The world production of aluminium in 1927 is said to be in the neighbourhood of 450,000,000 lb., the United States producing about 160,000,000 lb. of this great total. New plants are coming into operation in many different countries and one now under construction on the Saguenay River in Canada will be the largest in the world. Italy, France, Norway, Poland, Japan and other countries are also becoming producers of aluminium, so that a period of severe competition seems to be looming ahead in this industry.



[*South African Railways and Harbours Courtesy*]

A fine girder bridge across the Gonritz River, Cape Province

The Longest Concrete Bridge in France

A smart engineering feat was recently accomplished in France, when a bridge frame weighing 540 tons was successfully manœuvred into position across the mouth of the River Elorne in the Province of Brittany. When completed the bridge will have three spans each 585 ft. in length and the total length will be 3,900 ft. Three tiers are being built on the bridge to accommodate road, tram and rail traffic. The bridge will be the longest armoured concrete bridge in France, and will afford direct road and rail connection between any town south of the Elorne, and Brest, the great French Naval depot.

* * *

New Thames Bridge Scheme

A report prepared by a number of eminent engineers offering suggestions to relieve the present traffic congestion around the Strand and Charing Cross area is shortly to be placed before the Prime Minister. It is proposed that the existing Charing Cross Station should be demolished and Waterloo Station extended to cope with the rail traffic diverted from Charing Cross. A new road bridge running from near the Nurse Cavell statue to Waterloo Road would be constructed and the existing Hungerford footbridge and Charing Cross Railway Bridge demolished. Waterloo Bridge should be widened to take four lines of traffic. The estimated cost of the scheme is £10,770,000.

* * * *

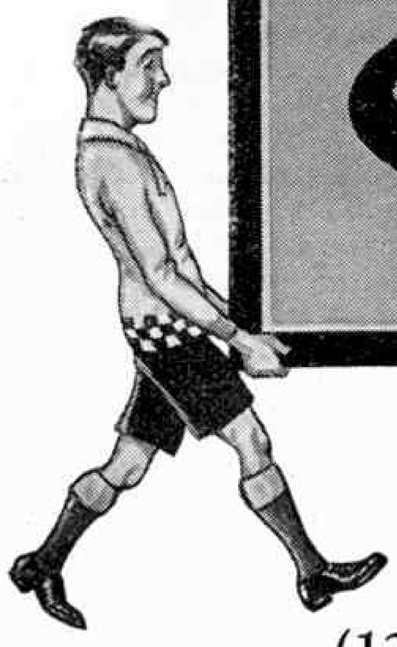
British Motor Cycles in New Zealand

It is interesting to learn that of a total of 33,580 motor bicycles in use in New Zealand, 21,320 are of British manufacture. The most popular British machine is the "Douglas," of which 4,564 are in use. The "Triumph" comes next with 3,781, then the "B.S.A." with 3,490, followed by the "A.J.S." with 1,772.

* * * *

Pile Sinking Without Noise

An interesting method of pile-driving by compressed air has recently been introduced which is stated to do away with the noise and vibration hitherto inseparable from this type of work. Ordinary well tubing is sunk until the requisite depth is reached and concrete is then poured into the tube. The top of the tube is temporarily closed and air at a pressure of 150 lb. per sq. in. is pumped in, forcing the concrete into the ground round the foot of the tube. Before the concrete has set the tube is raised slightly, and the operation is repeated. This is continued until the concrete reaches ground level. Reinforcing rods are embedded in the concrete. One great advantage of this method is that piles can be sunk at any angle desired.



Suggestions Section

Edited by "Spanner"

The ideas printed in the "Suggestions Section" should prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for Suggestions published showing special merit. Contributions should be accompanied by clear photographs or drawings and should be addressed to "Spanner," c/o The "Meccano Magazine."

(126)—Meccano Demonstration Model of Corliss' Valve Gear

ON this page we illustrate a Meccano model of the Corliss valve gear, a type that is used on mill engines and other slow speed engines. It is an extremely interesting model and demonstrates faithfully all the characteristic movements of its prototype.

In the Corliss gear, unlike most others, there is a separate exhaust and inlet valve for each end of the cylinder. There are thus four valves in all. They are given an oscillatory movement by means of a "wrist plate" that is actuated by an eccentric mounted on the crankshaft. Means are adopted to vary automatically the cut off by a centrifugal governor as the speed alters.

The "wrist plate" 2, which consists of a Bush Wheel, is free to turn about a Pivot Bolt that is secured to the 5½"×3½" Flat Plate forming one side of the cylinder block. The links connecting the four valves 7, 7a, 11, and 11a, consist of 2½" Strips that are attached pivotally to the wrist plate by ⅜" Bolts. The latter serve also to secure in place a 2½" Strip 14, a nut being placed on each side of the Bush Wheel to hold the ⅜" Bolts firmly in position. Care should be taken that all four Strips turn freely on their Bolts, and a Washer should be placed on each Bolt between the pair of 2½" Strips.

The Eccentric 1 is secured on a 4½" Rod journalled in 2½" Triangular Plates and is connected to the wrist plate 2 by a 5½" Strip. This Strip is attached pivotally to the end of the Strip 14 by a Pivot Bolt, a Collar being placed on the latter for spacing purposes. The two exhaust valve cranks 11 and 11a are attached pivotally to their respective links by lock-nutted bolts (see Standard Mechanism No. 263). The Cranks are mounted on the ends of 3" Rods that are journalled in the side plates, Collars holding the Rods in place.

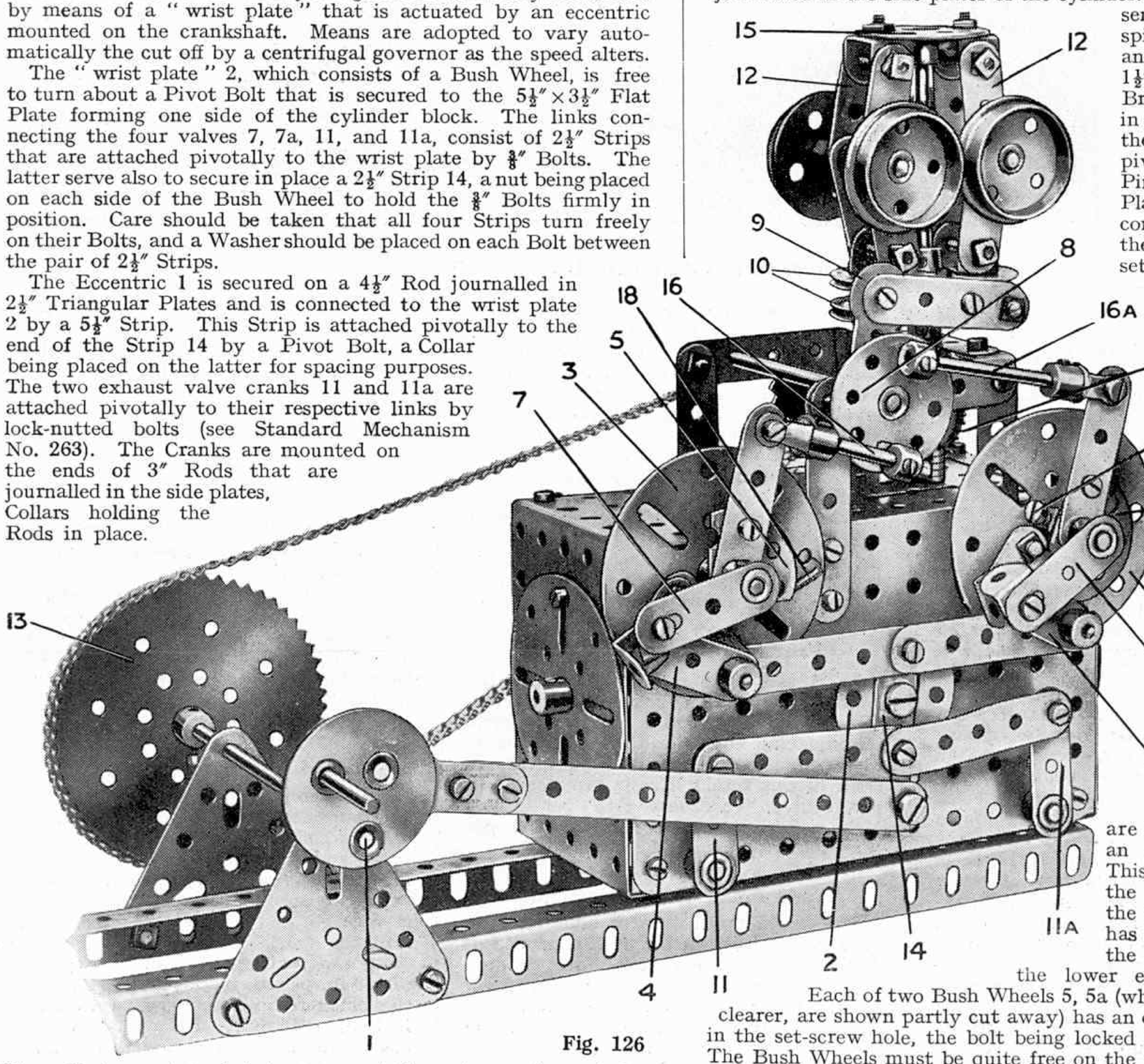


Fig. 126

These Rods are intended to represent the rotary valves of the Corliss type, which, when rocked by the wrist plate, alternately open the ends of the cylinder to exhaust.

The steam valves on the end of the spindles on which the Cranks 7, 7a are secured, have to be operated by a slightly more complicated mechanism than the exhaust valves, for it is necessary that the time during which the steam is entering the cylinder for any one stroke of the piston must be capable of modification by the governor. To this end the steam valve Cranks 7 and 7a are each operated by a trip mechanism, which trips the cranks earlier as the speed of the engine increases, so diminishing the amount of steam admitted. This is known as the "cut off."

The Face Plates 3 and 3a are mounted loosely on 4½" Rods journalled in the side plates of the cylinder. The 4½" Rods represent the steam valve spindles. Each trip 4 and 4a consists of two 1½" Strips and a Flat Bracket bolted together in the form of a triangle, the apex of which is pivoted on a Threaded Pin secured to the Face Plate 3 or 3a. In the construction of each of the trips 4 and 4a the set-screws extracted from Bush Wheels, etc., are used instead of ordinary bolts, which are too long for the purpose. A ½"×½" Angle Bracket is bolted to each trip by its slotted hole as indicated in the illustration. Before placing the trips on the Threaded Pins the connecting links from the wrist plate should be mounted on the Pins. Here it should be noted that the connecting links for the exhaust Cranks are slightly bent to form an efficient connection. This is the case also with the connecting link to the Face Plate 3a, which has to be bent towards the Face Plate to clear the lower edge of the trip 4a.

Each of two Bush Wheels 5, 5a (which, to make matters clearer, are shown partly cut away) has an ordinary bolt inserted in the set-screw hole, the bolt being locked in position by a nut. The Bush Wheels must be quite free on the valve spindles. A 2" Strip is now bolted to each Bush Wheel, so that the bolt on the boss of the Bush Wheel 5 is pointing—to use a clock face as a comparison—to 5 o'clock while the bolt 6 on the boss of the Bush Wheel 5a points to 10 o'clock. Two Washers are placed on each valve spindle and lastly, the two Cranks 7 and 7a are secured in place. A ½"×½" Angle Bracket is bolted in the end hole of

each Crank as shown. Short lengths of Spring Cord 18 are secured to the trips 4 and 4a and to the Face Plates 3 and 3a, so that the trips normally are held against the bosses of the Bush Wheels 5 and 5a.

The 5″ Rod carrying the governor is journalled in a 2½″ Strip and in a hole of the 5½″×2½″ Flanged Plate forming the top of the cylinder. A Collar and three Washers on the lower end of the 5″ Rod take the downward thrust of the governor. The links 12 (1½″ Strips) are attached pivotally at their top ends to Double Brackets bolted to the Bush Wheel 15 and at their lower extremities to the 2″ Pulleys 10. The Pulleys 10 are secured rigidly to each other by ½″ Bolts, a Collar and Washer on each bolt spacing the Pulleys a short distance apart. The Pulleys 10 must slide quite freely on the 5″ Rod. The drive for the governor is taken off the 3″ Sprocket Wheel 13 to a 1″ Sprocket on a short Rod that is journalled in a Double Bent Strip bolted to an upright Strip at the rear of the model. The short Rod carries a 1½″ Contrate 17 that meshes with a ½″ Pinion on the 5″ Rod.

The Simple Bell Crank 9 is bolted to a Crank that, in turn, is secured to the 3″ Rod carrying the Bush Wheel 8. One arm of the Bell Crank 9 is extended by a 2″ Strip that has a Threaded Pin bolted to it, so that the Pin rests in the space between the two 2″ Pulleys 10.

Two Collars (new style) are attached in diametrically opposite holes in the Bush Wheel 8 by ordinary bolts, nuts being locked against the Collars to prevent the bolts working loose. The 1½″ Rod 16 is attached to the 2″ Strip on the Bush Wheel 4 by means of an End Bearing, and the 2″ Rod 16a is attached to the 2″ Strip on the Bush Wheel 4a in a similar way.

In the illustration the Crank 7a is about to be lifted by the Angle Bracket on the trip 4a engaging with that on the Crank as the trip rises. As the trip moves, it rides up the bolt 6, which thrusts it outward to the left. Presently the Crank 7a is released and flies back under the action of a piece of Spring Cord attached to a Crank secured to the valve spindle at the rear of the model. This Crank normally is held by the tension of the Spring Cord against a stop consisting of a Threaded Pin so that directly the Crank 7a is released by the trip, it flies back on to the stop. (The Crank 7 is controlled in a similar manner).

It is now the turn of the left hand valve to come into operation. In this case the Crank 7 is drawn downward by the trip 4 instead of upward as in the case of the right hand valve. It is evident that as the two steam valves open alternately, the exhaust valves must do the same, so that when the left hand valve is open to steam the right hand exhaust valve is open, and vice versa.

As the governor weights fly out with increase of engine speed the Pulleys 10 rise and pull up the arm of the Bell Crank 9, so partially rotating the Bush Wheel 8. This in turn alters the position of the Bush Wheels 5 and 5a, so that the trips ride up their respective Bolts and trip the Cranks 7 and 7a earlier in the stroke and cause the engine to work with a shorter cut off.

By altering the position of the Rods 16 and 16a in their respective Collars both valves may be arranged to lift an equal amount by their trips. The Angle Brackets on the trips and Cranks 7 and 7a must be adjusted very carefully.

(127)—Meccano Recording Calipers

(T. J. Hobbs, Birmingham)

Meccano measuring instruments are very popular with many "*M.M.*" readers, for quite accurate measurements may be made with their aid. The Meccano spherometer described in the "Suggestions Section" of the May "*M.M.*" is a good example of this kind of model and this month we are able to give particulars of another instrument of a similar kind.

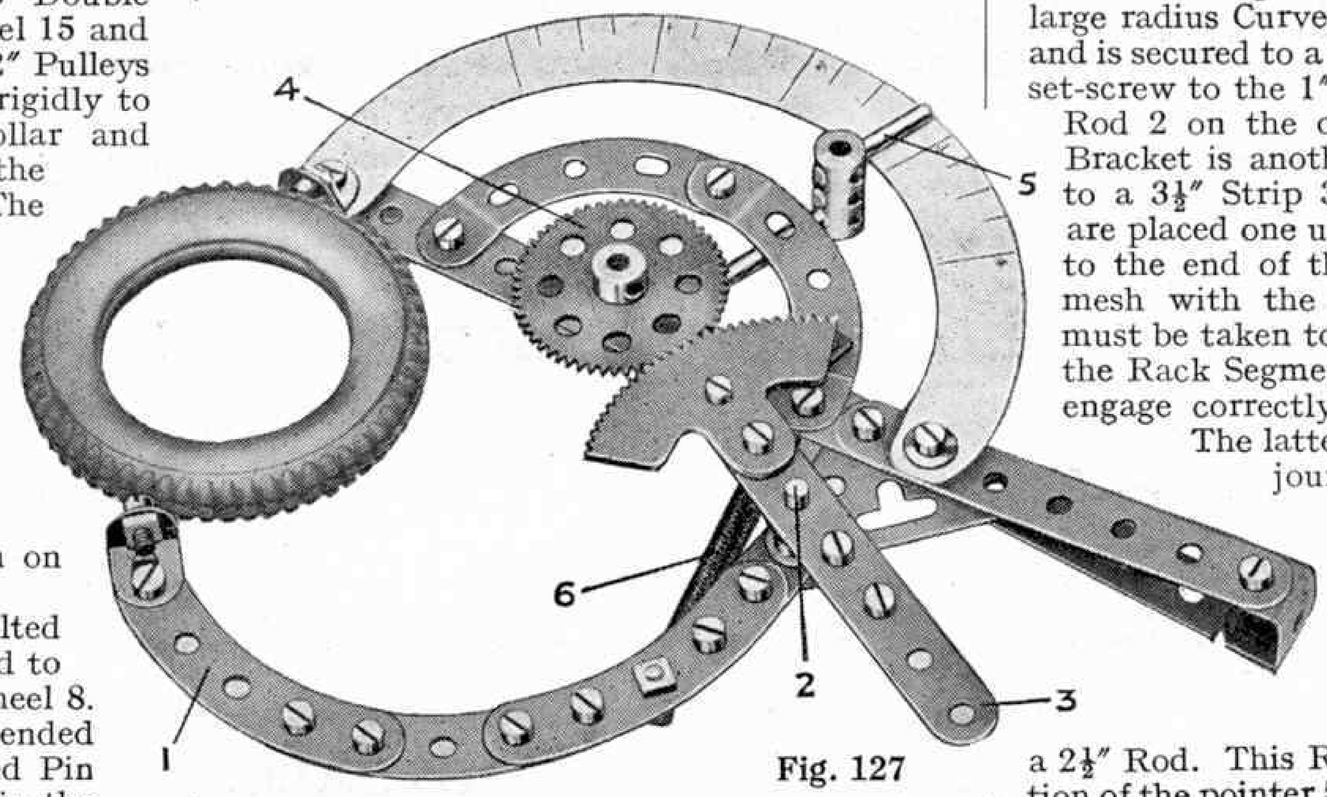


Fig. 127

The Meccano recording calipers are designed for measuring the outside diameter of objects. The size of the object is shown directly on a scale instead of having to refer to a rule, as is the case with calipers of the usual type.

The portion of the model to which the cardboard scale is attached consists of a 5½″ Strip to which two 3½″ Strips are bolted to form a convenient handle. The 3½″ Strips are bolted one on each side of the 5½″ Strip, their free ends being bent apart slightly to enable a Double Bracket to be inserted between their ends. A Corner Bracket, in which the 1″ Rod 2 is journalled, is secured also by the Bolts that fix the handle to the 5½″ Strip.

The moving arm consists of three 2½″ large radius Curved Strips bolted together, and is secured to a Crank that is fixed by its set-screw to the 1″ Rod 2. Secured to the Rod 2 on the other side of the Corner Bracket is another Crank that is bolted to a 3½″ Strip 3. Two Rack Segments are placed one upon the other and bolted to the end of the Strip 3. Their teeth mesh with the 57-teeth Gear 4. Care must be taken to ensure that the teeth of the Rack Segments coincide so that they engage correctly with the Gear Wheel. The latter is fastened on a 1″ Rod journalled in a Double Arm Crank that is bolted to the 5½″ Strip.

On the lower end of the Rod carrying the Gear 4 a Coupling is secured and in its longitudinal bore is gripped a 2½″ Rod. This Rod forms the longer portion of the pointer 5.

The pointer 5 is returned to normal by means of a Spring 6, which is attached to both the moving and fixed arms by ⅜″ Bolts.

The parts used in this model are:—

1 of No. 2	22 of No. 37	2 of No. 63
3 „ „ 3	4 „ „ 37A	3 „ „ 90
2 „ „ 12	1 „ „ 38	2 „ „ 90A
1 „ „ 17	1 „ „ 43	3 „ „ 111C
3 „ „ 18B	2 „ „ 62	2 „ „ 129
1 „ „ 27A	1 „ „ 62B	1 „ „ 133

(128)—Meccano Boat Steering Gear

(J. K. Robinson, Manchester)

The device shown in Fig. 128 will doubtless be welcomed by model boat enthusiasts. It may be used in numerous Meccano models of ships—in some cases, of course, with slight alterations to its layout.

The 5½″ Strip that represents the tiller is bolted to a Bush Wheel that in turn is secured to the end of a short Rod. This Rod is journalled in a footstep bearing consisting of a ½″ Reversed Angle Bracket bolted to the 5½″×2½″ Flanged Plate.

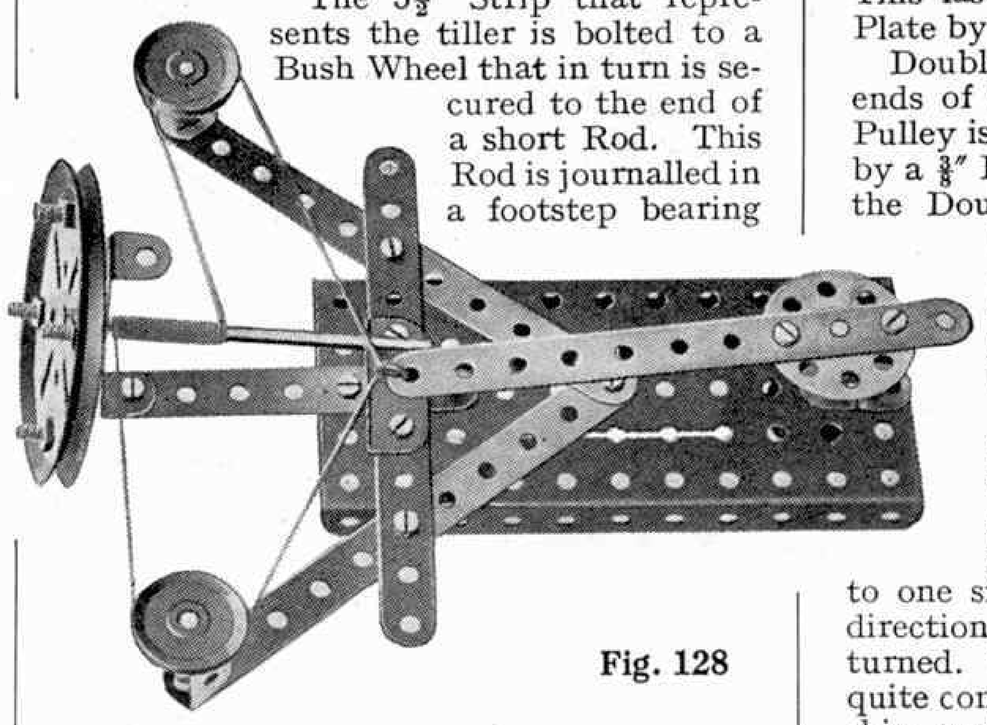


Fig. 128

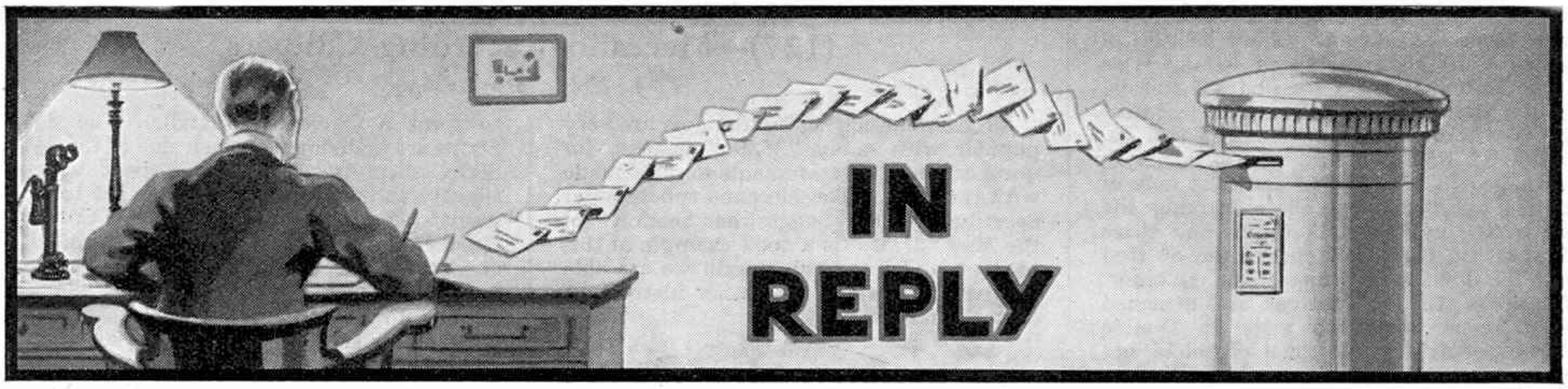
At the opposite end of the Plate a 2½″×½″ Double Angle Strip is bolted in a vertical position to a 3½″ Strip that in turn, is secured to the Flanged Plate. The Double Angle Strip forms a bearing for one end of the 3½″ Rod on which is mounted the 3″ Pulley representing the steering wheel. The other end of the 3½″ Rod is journalled in a Trunnion secured to the Plate. Two 5½″ Strips are bolted together in the sixth hole from the tiller end of the Flanged Plate, and are braced apart by a further 5½″ Strip. This last Strip is secured to the Flanged Plate by the bolts that retain the Trunnion.

Double Brackets are fixed to the outer ends of the two 5½″ Strips, and a 1″ fast Pulley is mounted on each Double Bracket by a ⅜″ Bolt. The latter is passed through the Double Bracket and secured in the boss of the Pulley by the set-screw. A length of cord is taken round the 4½″ Rod several times, and each end is then passed over the 1″ fast Pulleys and secured to the tiller.

It will now be seen that as the Rod carrying the steering wheel is rotated, one end of the cord is paid out while the other is wound on to the Rod. Hence the tiller is pulled to one side or the other according to the direction in which the steering wheel is turned. The steering wheel may be placed quite conveniently on the bridge of a model ship and the cords taken to the tiller through suitable guides fixed to the deck or inside the hull.

The parts required to build the mechanism as illustrated are as follows:—

4 of No. 2	1 of No. 19B	1 of No. 48A
1 „ „ 3	3 „ „ 22	1 „ „ 52
2 „ „ 11	1 „ „ 24	6 „ „ 111C
1 „ „ 12	14 „ „ 37	1 „ „ 126
1 „ „ 16	4 „ „ 37A	
1 „ „ 18A	1 „ „ 40	



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested Meccano Improvements

IMPROVED H.V. ELECTRIC MOTOR.—We note that you consider that bushes should be fitted to the additional holes in the H.V. Motor. No doubt smoother running would result as more bearing surface would be given, and we will give further thought to your idea. (*Reply to D. Garnett, Bournemouth*).

FREE-WHEEL MECHANISM.—A miniature free-wheel is not a suitable addition, we consider, for quite a compact article can be built up from existing parts. (*Reply to S. Senhouse, Sheffield*).

IMPROVED FLANGED WHEEL.—We note that you consider that the diameter of the Flanged Wheel, part No. 20, should be increased. Your suggestion is receiving further consideration. (*Reply to L. Williams, Ramsgate*).

WIRE WHEELS.—These parts would certainly enhance the appearance of model cars, but parts that are purely ornamental are never introduced to the system. (*Reply to E. C. Gardener, Norwich*).

1" STRIP.—We have received a considerable number of suggestions regarding this article but we do not see our way to introduce it as yet, as the Flat Bracket serves as quite an efficient substitute. (*Reply to L. Smith, London, W.5; D. H. Gordon, Ipswich, and others*).

UNIT SYSTEM OF MOTOR CONSTRUCTION.—We were interested in your suggestion that the armature, commutator, field magnets, etc., which comprise the Electric Motor, should be listed separately so that the complete Motor might be built up. We will file your idea for further reference. (*Reply to D. Garnett, Bournemouth*).

THREE-THREAD WORM WHEEL.—We were interested to hear that you have constructed a wheel of this type which will mesh with the standard Gear Wheels. We do not think that its introduction is advisable, and moreover, we feel sure that smooth working would be difficult to obtain when using this part. (*Reply to J. K. Lockhart, Edinburgh*).

ALUMINIUM IN MECCANO.—We fear that it would be impossible for us to introduce to the system articles manufactured from this metal as their cost would be very great. (*Reply to R. Johnson, Birmingham*).

DOUBLE CRANK.—We were interested in your idea concerning a Strip having a boss attached to each end, the bosses being placed on alternative sides of the Strip. Your suggestion will receive further thought. (*Reply to L. Hale, W. Bromwich*).

SINGLE SIDED EYE PIECE.—An eye piece of this type would have few uses if introduced, and it should be possible to use existing parts in its place. (*Reply to Victor Thompson, Lincoln*).

FIBRE GEAR WHEELS.—The cost of manufacturing Gear Wheels of this type on a small scale prohibits us introducing them to the Meccano system. (*Reply to R. T. Wood, Southampton*).

ALTERATION TO ELECTRIC MOTOR.—We note that you consider the position of the terminals on the new electric motor somewhat inconvenient. To place the terminal block at the top instead of the bottom of the Motor would certainly be an improvement. We will give further attention to your idea as we consider it distinctly good. (*Reply to C. K. Kernahan, Belfast*).

2-VOLT ACCUMULATORS.—There is little need for us to introduce special 2-volt accumulators, as by taking a tapping off the lead connecting-bar of the existing 4-volt model, a 2-volt supply can be obtained. (*Reply to J. B. Neal, Reading*).

METAL MODELS OF BOATS.—Although your idea is interesting, we cannot consider the manufacture of model boats built from thin aluminium plates. (*Reply to G. E. Hopcroft, Southampton*).

A MECCANO FOOTBALL?

No doubt our readers will find several uses for this novel sphere built by Mr. A. H. Finlay of Holywood, Co. Down, but we do not consider that it would form a very suitable football!

Lined with coloured paper and fitted with an electric lamp, the sphere would form a very pleasing decoration, however. Incidentally, it might be used as a "problem model," for a great deal of concentration is necessary to discover exactly how many pentagons and hexagons are included in its design!

SPRINGY STRIPS.—We were interested in your suggestion that special springy perforated strips should be introduced for use in building up the elliptic springs on the new Motor Chassis. Your idea will receive further consideration (*Reply to P. R. Hall, Leicester*).

COLOURED LAMPS.—Your suggestion that small coloured lamps should be supplied in addition to the plain variety interests us. Incidentally they could be used in the Flashing Sign model described on another page of this issue. (*Reply to L. Chatsworth Stockton Heath*).

FLAT SECTOR PLATES.—This article would no doubt form quite a useful addition to the system. Further thought will be given to your idea. (*Reply to R. J. Winthrope, Stoke-on-Trent*).

NEW RODS.—Axle Rods having each end screwed would no doubt find several uses in the system. Your idea will receive due attention. (*Reply to F. Littleworth, London, W.*)

MECCANO REFLECTOR.—The question of introducing a reflector (to be used in conjunction with the Lamp and Lamp Holder) is receiving our attention and a further announcement on this subject will appear later. (*Reply to J. S. Coleburn, Bristol*).

FIBRE WASHERS.—We do not consider that there is any need for the introduction of fibre washers for the protection of the enamel, and your suggested washers are therefore unnecessary. (*Reply to Gregory Spruson, Neutral Bay, N.S.W.*)

MECCANO BELT.—A belt of the type that you suggest would no doubt find several uses, and your idea will receive consideration in the future. (*Reply to R. T. Hedges, Stoke-on-Trent*).

WINDING DRUM.—Numerous suggestions have been received for fastening cord to the Crank Handles, but your idea appears to be a most satisfactory one and will receive attention in due course. (*Reply to S. J. Poole, Beckenham*).

RUBBER CORD.—Elastic bands can quite easily be used where a light belt drive is required. Rubber cord, however, would no doubt be found quite useful if incorporated in the smaller Outfits. (*Reply to J. Nightingale, Melbourne, Australia*).

LONGER FUNNELS.—Where a long funnel is required (i.e. in models of donkey engines, etc.) it can be built up from a number of Sleeve Pieces fastened together. (*Reply to Allen Beetlestone, Stonnall*).

ANNULAR WHEELS.—The question of introducing this type of wheel has received our attention for some time past, and we will no doubt be able to give a definite announcement on this subject later. (*Reply to C. L. Beaven, London, S.E.12*).

MOTOR CAR BODIES.—It would be totally impossible for us to introduce miniature model bodies of various makes of cars. Every Meccano boy should take a pride in devising different shapes of car bodies from existing parts. (*Reply to F. A. Dimes, Ashstead*).

BOBBIN HOLDER.—We were interested in your suggestion that a single Bent Strip having its sides curved so as to grip a wound bobbin should be produced. We will make a special point of giving attention to your idea. (*Reply to R. Wallace, Durban, S. Africa*).

IMPROVED RACK STRIPS.—We are afraid that little improvement can be made to the present method of joining Rack Strips or Segments. Slight irregularities are present, we agree, but these should not be the cause of much trouble. (*Reply to D. Garnett, Bournemouth*).

HEXAGONAL NUTS.—We were interested in your suggestion, and agree that nuts of this kind would somewhat simplify model-building. We are therefore giving further thought to your idea. (*Reply to C. J. Parker, Chester*).

CURVED RACK STRIPS.—We have received several suggestions regarding this part, but we do not feel justified in introducing it as we consider the Rack Segment fulfils all its uses. (*Reply to R. Helton, Bristol; J. Riley, Bolton, and others*).

CHANNEL GIRDERS.—There is no need for us to introduce these parts as the existing Angle Girder can be used to build them up quite easily. (*Reply to V. King, Sheffield*).

Suggested Hornby Train Improvements

GUARD'S VAN FOR No. 2 TRAINS.—A guard's van is now all that is required to complete a No. 2 Pullman train and in view of the fact that at present we do not manufacture one suitable for running in conjunction with the Pullman Cars, etc., we will give your idea careful consideration. See reply to "Composite Coaches." (*Reply to R. C. Robinson, Rushden, Northants.*)

SLIP COACHES.—We are constantly receiving suggestions that we should introduce some kind of slip coach apparatus for Hornby Train working. The experiments that we have already carried out have proved very satisfactory and we hope to make a further interesting announcement on this subject. (*Reply to J. W. Piggott, Birkenhead*).

MODEL MOTOR LORRIES.—We are filing your suggestion that we should introduce Hornby motor lorries. Although we agree that a lorry is one of the commonest objects to be seen in any goods yard, we consider that there are more important additions to be made to our stock of actual railway models. (*Reply to W. Lloyd-Jones, Derby, and Ivor Kemp, Sutton Coldfield*).

A RECTANGULAR TAR WAGON.—We agree with you that this would be a popular addition and we are therefore filing your letter for further consideration. (*Reply to Harold Wilson, Huddersfield*).

A COMBINED SIGNAL AND BRAKE RAIL.—Your idea is very interesting, though we feel that it should not be impossible for a Hornby enthusiast to interconnect a brake rail and signal at home, so that both can be worked from the same point lever. (*Reply to R. Wilmer, Axminster*).

LARGER BOGIES ON No. 3 ENGINES.—We agree that the appearance of this engine would be improved if a larger bogie were fitted. It should be remembered, however, that the whole frame would have to be extended to accommodate a new leading bogie. In the circumstances we do not think it advisable to adopt your idea. (*Reply to R. J. Dippy, Old Bexley*).

SIX-WHEELED WAGONS.—Six-wheeled wagons are not very common on actual railways, while six-wheeled 20-ton brake vans are in use almost everywhere. We feel sure that brake vans would be more popular, and we are considering introducing this type of van. (*Reply to H. G. Rayment, Hastings*).

HORNBY STEAM LOCOMOTIVES.—It has often been suggested that we should introduce steam engines into the Hornby system. At the present time this is altogether out of the question, but it is possible that later we may give the matter consideration. (*Reply to Norman Fisher, Edinburgh*).

MODEL TARPAULINS.—Hornby Train owners will no doubt be pleased to hear that we have definitely decided to manufacture model tarpaulins. (*Reply to G. Hood, London, S.E.*20).

AUTOMATIC SIGNAL.—We would refer you to the Hornby Control System which affords possibilities for operating signals from the signal box. We do not think there is much interest in an engine tripping a lever and thus actuating its own signal. (*Reply to P. Hannan, Tonbridge*).

A "DEELEY" COMPOUND LOCOMOTIVE.—We are considering the introduction of a model of a "Deeley" compound locomotive as we are confident that this type, which has so many admirers, would appeal to the majority of Hornby train enthusiasts. (*Reply to J. M. Miller, Alloa, N.B.*)

LARGER DRIVING WHEELS ON No. 1 ENGINE.—We are afraid that you are under a misapprehension when you state that larger driving wheels would give greater power to No. 1 locomotives. These engines, if fitted with larger wheels, would certainly travel further, but they would be correspondingly less powerful. We do not propose to adopt this idea. (*Reply to H. P. Jerwood, Rutland*).

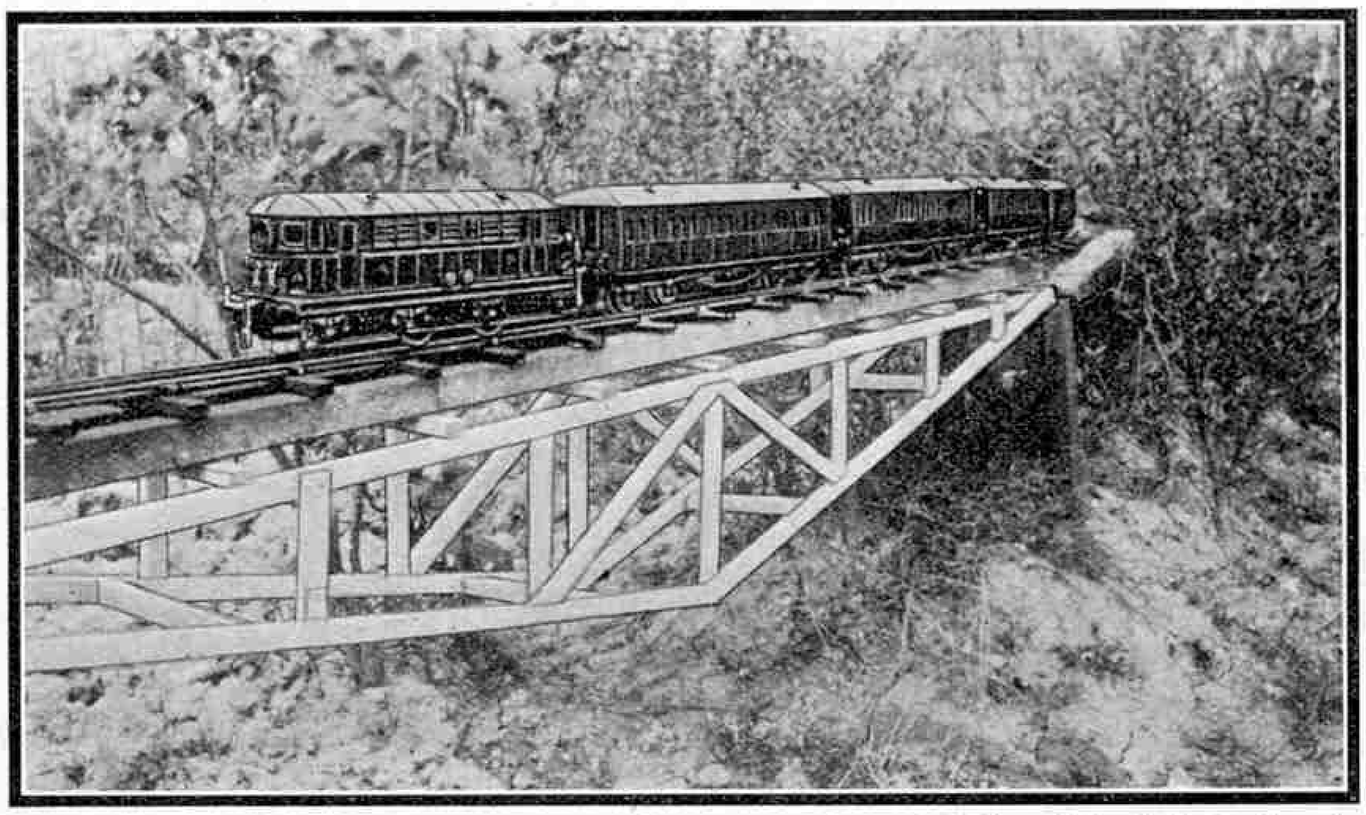
HORNBY SLEEPERS.—We do not think there would be any particular advantage in colouring the sleepers of Hornby rails brown instead of black and we very much doubt your idea that they would look more realistic. (*Reply to E. W. Parry, Heaton, Bolton*).

ELECTRIC TANK ENGINES.—Experiments are now being carried out with a view to improving and increasing the range of Hornby Electric Locomotives. We agree with you that electric tank engines would be very popular. (*Reply to M. Darwell, Bletchley*).

0-4-4 LOCOMOTIVE.—We are afraid that your proposal for a tank locomotive of 0-4-4 type with outside cylinders is not suitable. We do not think there would be enough difference between it and our present 4-4-4 engine to justify our manufacturing a model of this type. (*Reply to G. Allen, Manchester*).

METROPOLITAN STEAM LOCOMOTIVES.—Although Metropolitan steam trains are not represented in the Hornby Series, we produce an exceptionally good model of a Metropolitan Electric Engine which we think should satisfy Metropolitan Railway enthusiasts. (*Reply to J. Bruce, London, S.W.*11).

A GAUGE '0' ELECTRIC GARDEN RAILWAY



Our photograph illustrates a "Metropolitan" express on the main bridge of Mr. C. H. Bradnam's "Windyridge" electric railway, Bexhill-on-Sea, a detailed description of which appeared in the April 1927 issue of the "Meccano Magazine." The whole of the traffic on this miniature railway is handled by three locomotives, of which two are models of Southern Railway engines, 4-4-0 tender and an 0-4-4 tank, and the third a Hornby Metropolitan engine. The Southern engines are fitted with Hornby mechanisms, the motors being built into the bodies when the line was electrified. Comparing the original Hornby Metropolitan with the Southern locomotives, it was found that the Metropolitan attained a scale of 70 m.p.h. with a load of 12 axles and, using the same load, scale speeds of 60 m.p.h. were calculated to have been performed by each of the other two engines.

Installation of the control system for signals and points has greatly facilitated the operation of this railway. The movements and speeds of the engines can, of course, be controlled by varying the current, but the owner finds that the control apparatus considerably assists him in carrying out his various operations, and in addition gives a far more realistic finish to the whole layout.

FISH VANS.—We agree that fish vans are used to a great extent on the actual railways. A model of one of these would certainly be very useful on a model railway. (*Reply to Gordon Judd, London, E.*7).

ARTICULATED SETS.—We are afraid that it would not be practicable to introduce an articulated train into the system, since the curves on most Gauge "0" layouts are rarely larger than 2 ft. radius. It would be necessary to allow a very unrealistic space between each pair of coaches. (*Reply to R. Jones, Hastings, and Gordon Judd, London, E.*7).

MODEL CARRIAGE CLEANING APPARATUS.—This type of accessory would not be in great demand, as Hornby enthusiasts would find it useless. Should it become necessary to clean the enamel on Hornby Coaches, it is advisable to use a small piece of chamois leather damped in warm water. (*Reply to C. E. Jordan, London, N.W.*5).

NEW CHIMNEY FOR "ROYAL SCOT."—We have been giving this matter consideration for some time, and we hope to effect an alteration in this respect before long. (*Reply to R. J. Dippy, Old Bexley*).

SCALE MODEL STATIONS.—We agree that our present type of Hornby Station is very much shorter than most actual railway platforms, to scale. Nevertheless, it should be remembered that, taking the scale of ¼ inch to the foot for Gauge "0," a model of the longest platform in Euston (L.M.S.) Station, which is 1,030 ft. in length, would be 21 ft. 5½ ins. You will understand that it is impossible to manufacture platforms even approaching the correct scale length, such as you suggest. (*Reply to E. Johnstone, Paisley*).

TRAVELLING CRANE.—We do not consider that it is necessary to manufacture a travelling crane for use with Hornby Trains. This can very easily be built from Meccano. (*Reply to T. Rogers, Maritzburg, Natal, S.A.*)

MORE DETAIL ON "M" LOCOMOTIVES.—If we adopted your suggestion, the price of the "M" Locomotives would have to be considerably increased. For this reason we do not consider an alteration would be popular. (*Reply to W. N. Menzies, Aberdeen*).

SIX-WHEEL BOGIE CARS.—The six-wheel bogie seems to be becoming less popular in actual practice. You will be interested to hear that we hope to introduce before long a faithful reproduction of one of the latest Pullman Cars. None of the new cars is fitted with six-wheel bogies in actual practice. (*Reply to Cedric Abbey, Swansea*).

COMPOSITE COACHES.—We propose to introduce shortly a model of a modern first-class Brake Composite Pullman Car. (*Reply to R. C. Robinson, Rushden, Northants.*)

NEW "PACIFIC" LOCOMOTIVE.—We have frequently stated in these pages that we cannot consider introducing models of the actual L.N.E.R. "Flying Scotsman" locomotives, as this would entail an entirely new six-coupled mechanism, which we cannot consider manufacturing at present. (*Reply to E. Hope Jones, Eton College, Windsor*).

SLIP CROSSINGS.—Slip crossings are far too complicated to be made in tinplate track. In any case this points arrangement is rarely required in Hornby layouts. (*Reply to C. D. Watts, Manningtree*).

SOUTHERN COACHES.—We have definitely decided to introduce Hornby Railway goods coloured and lettered in correct accordance with Southern Railway practice. (*Reply to L. Dicker, Manku, N.Z. "Southerner," and many others*).

FIRE-BUCKETS AND RACK.—This is quite an original suggestion for a platform accessory. We are keeping the idea by us, for further consideration. (*Reply to G. Hood, London, S.E.*20).

SINGLE TRACK LEVEL CROSSINGS.—Single track level crossings would certainly be very popular and are, in fact, more to be seen than the double track type. We have already decided to introduce them. (*Reply to S. G. Otley, London, N.*4).

"FAIRLIE" TYPE LOCOMOTIVE.—We fear that the cost of manufacture of a locomotive of this type would prove prohibitive. (*Reply to G. Holt, Newcastle*).

WATER TANKS FOR TANK ENGINES.—Your suggestion that the tanks on our tank locomotives should be fitted with small filling holes and taps is interesting, but we are afraid impracticable. Although we agree that the extra weight available for adhesion would improve the hauling capabilities of the engines in question we are afraid that the cost of effecting a change of this kind would be too great, and in addition there would be a continual risk of spoiling the clockwork mechanism inside the engine. (*Reply to D. Jenny, Higher Tranmere, Birkenhead*).

EIGHT-WHEELED PETROL TANK.—This type of vehicle is certainly very common in America, but we are afraid that, as it is hardly used at all on English railways, we cannot consider manufacturing it. (*Reply to L. Chatman, Paisley*).

SPRING COUPLINGS.—There would be no advantage to be gained by replacing ordinary couplings by spring ones on the Hornby Rolling Stock, and therefore we do not propose to adopt your idea. (*Reply to R. Johnstone, Hythe*).

Electricity Applied to Meccano

IX—Electric Flashing Sign

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil winding machine, a Meccano electric telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, ammeter, etc. This month we describe a remarkably interesting Meccano model, an electric sign. The letters in the sign appear and disappear one after the other automatically, and the sign can be used for all kinds of practical purposes.

As will be seen from Fig. 1, which is a general view of the apparatus, the sign is built separately from the operating switch gear. It may be hung like a picture from any convenient point. The Motor and switch gear can be placed out of sight and the connecting wires arranged neatly and as unobtrusively as possible.

The model should prove invaluable for such purposes as shop window displays and Meccano Club exhibitions, etc. The lettering in the sign may be changed, of course, to suit individual requirements, and the number of lamps employed may be increased or decreased as desired.

Fig. 2 is a rear view of the sign and switch gear, etc., while two of the switch units are shown in detail in Fig. 3. It will be seen from Fig. 2 that the framework is composed of 18½" Angle Girders connected at their ends by 7½" Girders. The letters may easily be cut out from a sheet of cardboard with the aid of a fret-saw or very sharp knife. In order that each letter may be illuminated evenly, transparent paper should be stuck on the rear of the cardboard so as to cover the stencilled lettering. By using transparent papers of different colours a very striking and handsome sign will be obtained.

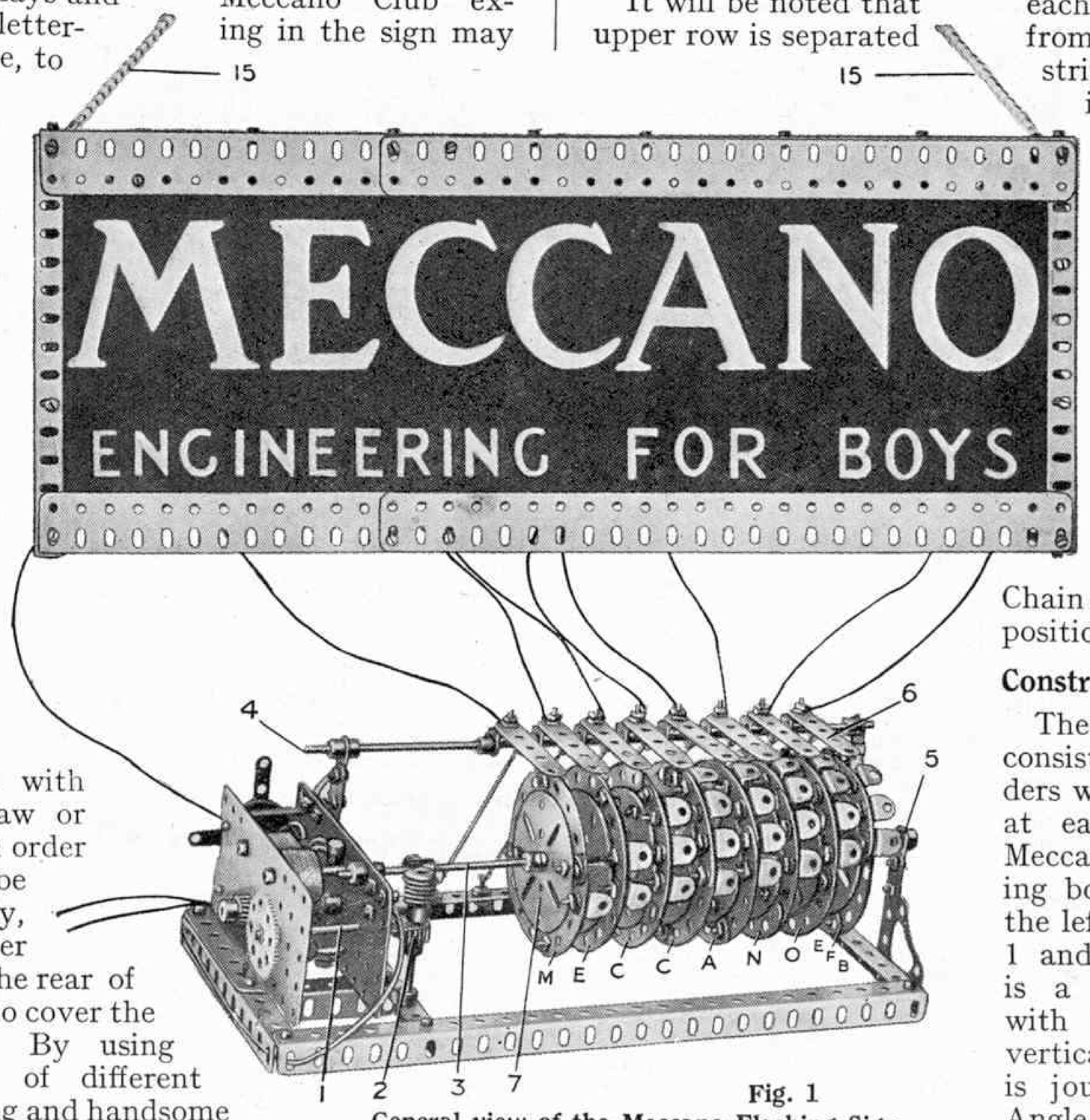


Fig. 1
General view of the Meccano Flashing Sign

The lamps that spell out the word "Meccano" are screwed into Meccano Lamp Holders that are secured to the Angle Girder 13 in the following manner. A 6 B.A. Bolt, with its head inside the Lamp Holder is passed through a hole in the Angle Girder 13 and an Insulating Bush is then placed on the shank of the bolt so as to insulate it from the Angle Girder. The metal portion of the Lamp Holder should be in contact with the other side of the Girder. The 6 B.A. Bolt is held in place by a 6 B.A. Nut, under which a length of insulated wire is clamped. This wire serves to connect the lamp to its respective brush on the "flasher."

In order that the four lamps on the lower Angle Girder 12 that illuminate the words "Engineering for Boys" shall light up simultaneously, the shanks of the 6 B.A. Bolts securing the Lamp Holders to the Girder 12 are all connected together by a length of wire 9. A continuation of the wire 9 serves to connect all four lamps to the last brush of the "flasher."

It will be noted that each of the lamps in the upper row is separated from its neighbour by a strip of cardboard that is bolted to a 4½" Double Angle Strip secured to the longitudinal 18½" Angle Girders. This is done so that each lamp shall illuminate only its own particular letter. A cardboard back may be provided to give a neat finish to the sign, which may then be suspended by the Sprocket Chain 15 in a conspicuous position.

Construction of the Flasher

The base of the "Flasher" consists of 12½" Angle Girders with 5½" Angle Girders at each end, the 4-volt Meccano Electric Motor being bolted down rigidly at the left hand end (see Figs. 1 and 2). On the Rod 1 is a Worm that meshes with a ½" Pinion 2 on a vertical 2½" Rod. This Rod is journalled in a 1"×1" Angle Bracket bolted to the Motor side plate and also in the 5½" Angle Girder that forms part of the base. The Rod carries at its upper end a second Worm that meshes with a ½" Pinion on the 11½" Rod 3, which is journalled in one of the Motor side plates. The other end of the Rod 3 is journalled in a Crank 5 that is bolted to an Architrave secured to the 5½" Angle Girder at the end of the base. Collars are used at each end of the Rod 3 to prevent side play.

One end of the 11½" Rod 4 is secured in a Crank bolted to a Corner Bracket on the Motor, the other end being held in a second Crank that is attached to an upright 3½" Angle Girder (Fig. 2).

Each of the Brushes 6 (Figs. 1, 2 and 3) consists of a $2\frac{1}{2}$" Strip that is attached to a Double Bracket by means of a 6 B.A. Bolt and Nut, the Strip being insulated from the Double Bracket in the usual way by an Insulating Bush and Washer. The completed brushes are threaded on the Rod 4, and spaced at the correct distances by means of Collars. Lengths of Spring Cord 14 are secured to each of the Brushes to keep them in close contact with the revolving switches, the free ends of the Cord being anchored to insulated 6 B.A. Bolts. The 6 B.A. Bolts are secured to the $12\frac{1}{2}$" Girder by means of a nut on each side of the Girder, so that the heads of the bolts project some distance above the Angle Girder.

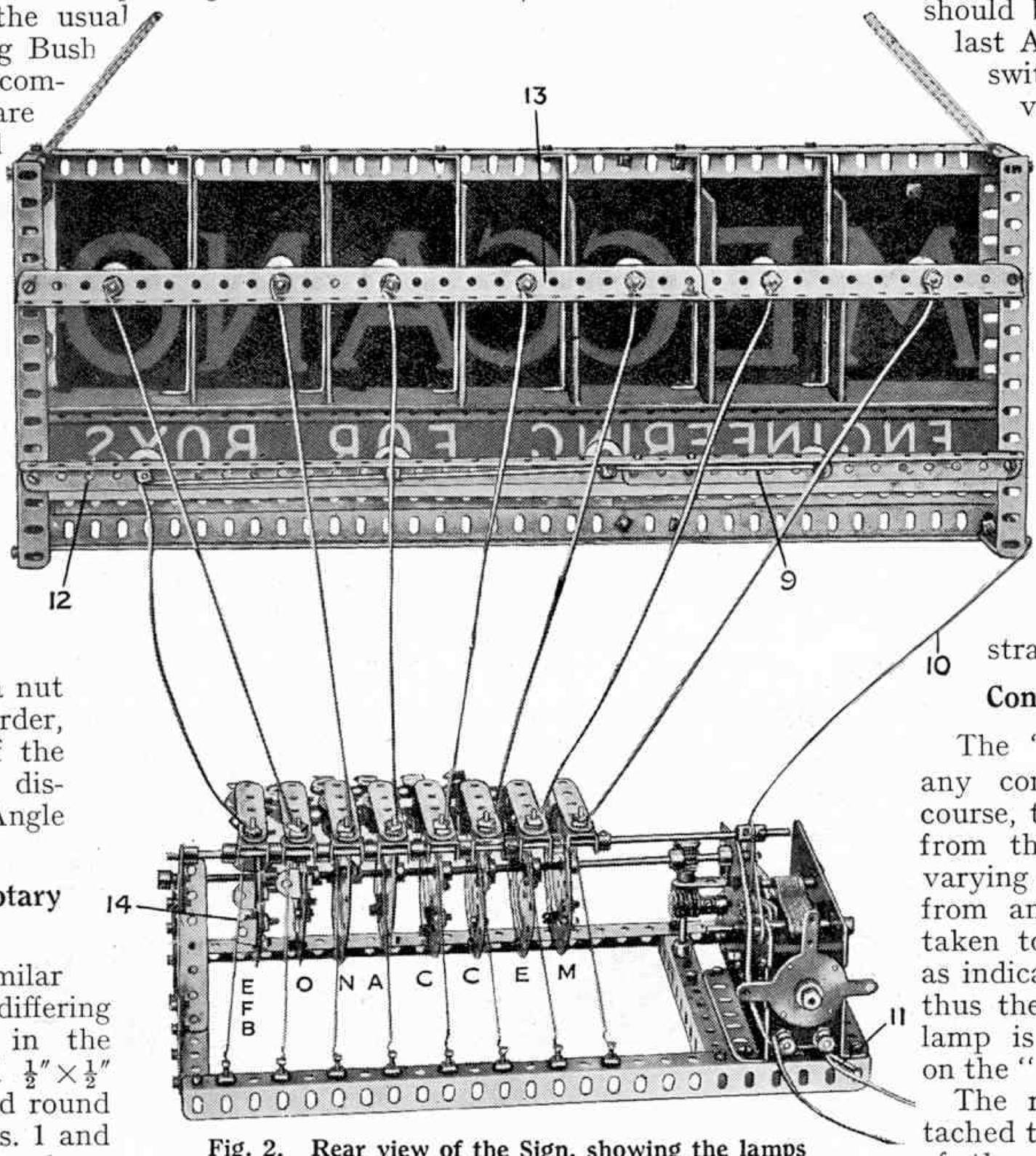


Fig. 2. Rear view of the Sign, showing the lamps that illuminate each letter

Construction of the Rotary Switches

Each switch is similar in construction, one differing only from another in the number of insulated $\frac{1}{2}" \times \frac{1}{2}"$ Angle Brackets placed round its periphery. In Figs. 1 and 2 the switches have been marked with the letters they control, in order to make the wiring of the model as easy as possible to follow.

First take the "M" switch (the right hand one in Fig. 3). It consists of a Face Plate 7, to which is secured by means of Flat Brackets a "rim" composed of four $2\frac{1}{2}$" small radius Curved Strips. A $\frac{1}{2}" \times \frac{1}{2}"$ Angle Bracket 8 is secured to, and insulated from, the rim by means of a 6 B.A. Bolt with an Insulating Bush and Washer.

The "E" switch is constructed in precisely the same manner, except that it carries two insulated Angle Brackets instead of one. The number of Angle Brackets increases progressively toward the last switch, which controls the E.F.B. ("Engineering for Boys") lamps and has eight Brackets. The other switch shown in detail in Fig. 3 is the "O" switch, which carries seven Angle Brackets arranged round its periphery, as will be seen from the illustration.

The switches should now be arranged in their correct order on the Rod 3 and secured rigidly in place. They should be placed so that the last Angle Bracket on each switch is slightly in advance of the preceding one, commencing with the "M" switch and working through the entire series of switches. This particular adjustment ensures that the letters on the sign run out rapidly backward and do not black out simultaneously. The latter effect may be obtained by arranging all the switches in a straight line.

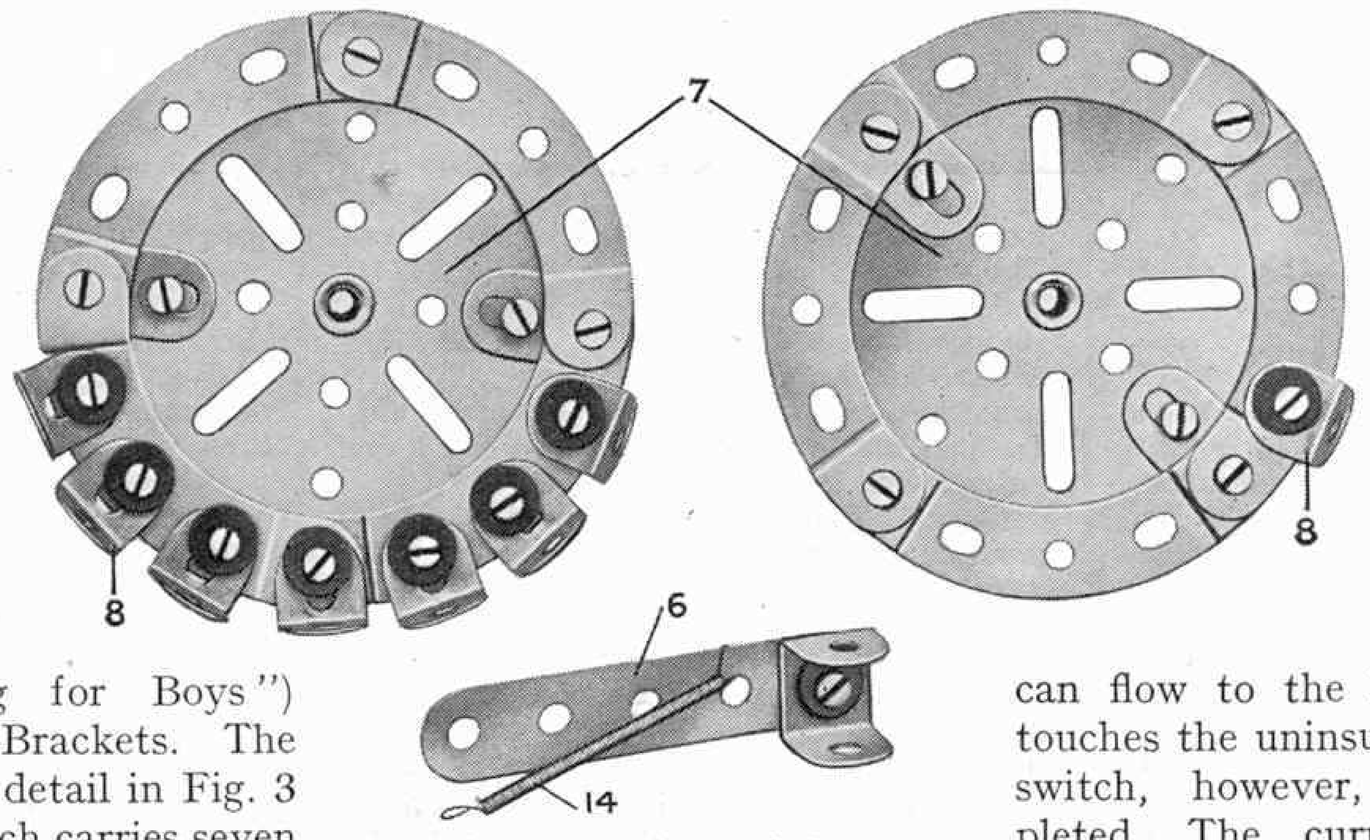


Fig. 3. Detail of two of the rotary switch units and brush gear

Connecting up the Model

The "flasher" may be in any convenient position, of course, the length of the wires from the lamps in the sign varying accordingly. The wire from any particular lamp is taken to its respective brush as indicated in Figs. 1 and 2; thus the wire from the "M" lamp is taken to the brush on the "M" switch, and so on.

The return wire 10 is attached to a point on the frame of the sign so that it is in metallic contact with the latter. The wire is taken then to one of the Motor terminals. A wire 11 is taken from the remaining terminal of the Motor and attached to a point on the Motor side plate close to the Rod 3.

On no account must the 8 amp. Meccano Accumulator be used, for the current taken by the model is large and would be beyond the capacity of the Accumulator. The latter would rapidly be spoilt if used for the purpose. The 20 amp. Meccano Accumulator, on the other hand, is quite suitable as a means of driving the model.

Action of the Model

So long as the insulated brushes 6 rest on the insulated Angle Brackets 8, no current can flow to the lamps. When a brush touches the uninsulated part of a rotating switch, however, the circuit is completed. The current then flows from the Motor terminal

(*Continued on page* 618)

Results of Meccano Model-Building Contests

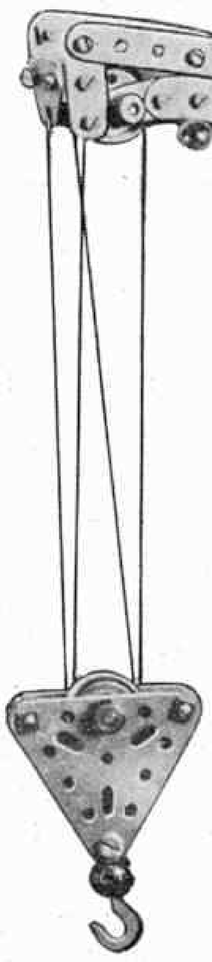
By Frank Hornby

"November" Competition, Overseas Section

THE prize-winners in the Overseas Section of the November Model-building Contest are as follows:—

FIRST PRIZE (cheque to value £3-3s.): R. O. Jukes, Timaru, New Zealand. SECOND PRIZE (cheque to value £2-2s.): William Isbister, Crow's Nest, Sydney, Australia. THIRD PRIZE (cheque to value £1-1s.): G. Tedeschi, Torino, Italy.

SIX PRIZES, each consisting of Meccano products to the value of 10/6: Alwyn McKellar, Rivonia, South Africa; P. and R. Hastings, Madrid, Spain; A. A. Sutton, Cremorne, N.S.W., Australia; Norman B. Scott, Winnipeg, Canada; Nelson Eustis, Alberton, S. Australia; Maurice Penrose, Hillbrow, Johannesburg, South Africa.



A realistic model, built by C. C. Sweet, of a Railway Breakdown Crane. Note the "outriggers," which take the strain and prevent damage to the bogie springs when the jib is working at right angles to the track

TWELVE PRIZES, each consisting of Meccano products to the value of 5/-. P. J. Noguera, Buenos Aires, Argentine Republic; F. G. Davies, Gatooma, S. Rhodesia; C. Galdies, Valletta, Malta; Franklin Hodge, Christchurch, New Zealand; E. Gordon Hannaford, Belair, S. Australia; S. A. Nathani, Chowpathy, Bombay, India; R. C. Vajifdar, Navsari, India; Frank Blundy, Burwood, Victoria, Australia; L. K. Blackmore, Wattamondara, New South Wales; E. Wood, Pretoria, S. Africa; D. Miller, Melbourne, Australia; E. Eales, Brisbane, Australia.

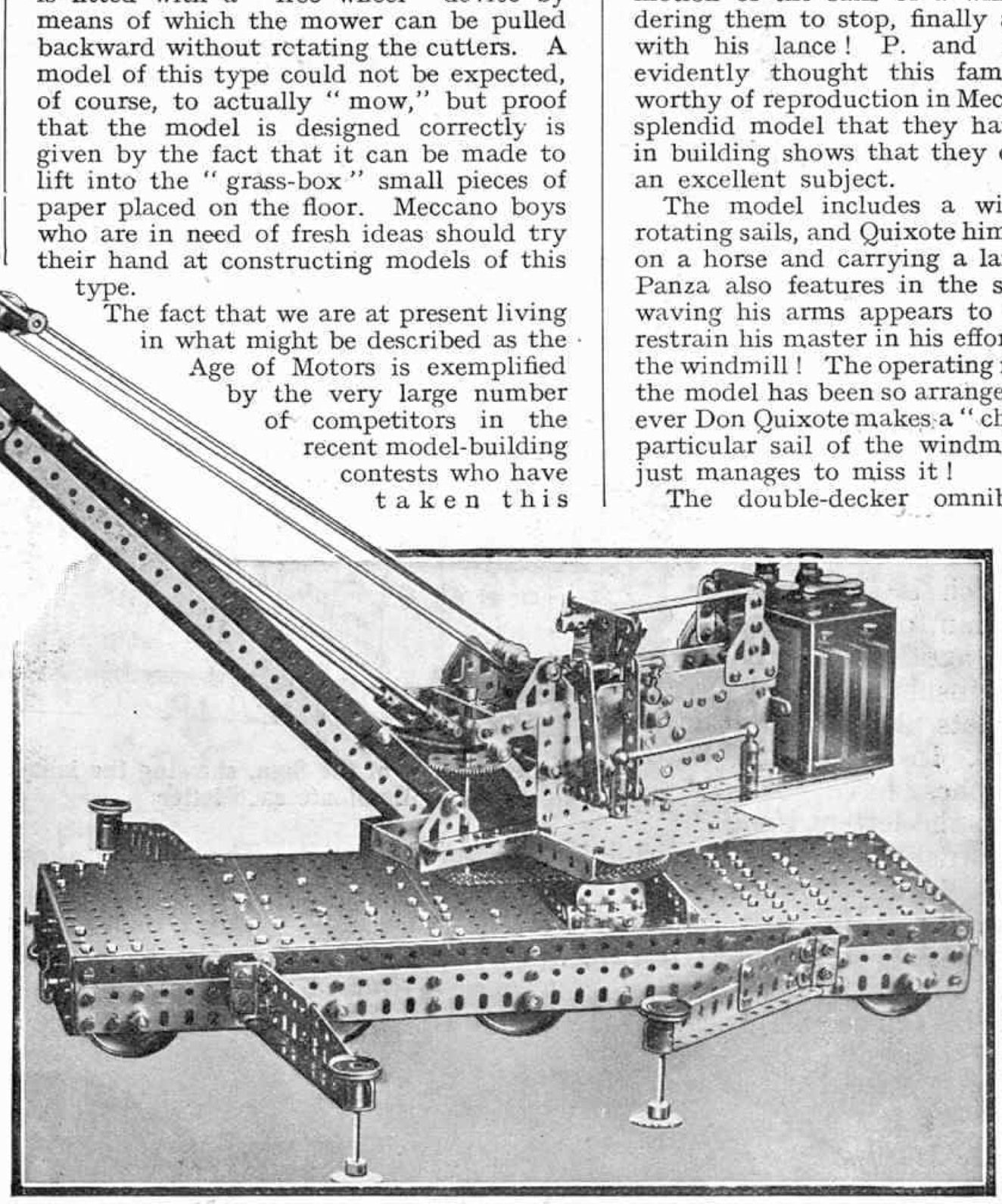
SPECIAL COMMENDATION (Certificates of Merit): I. K. Menon, Malabar, India; P. G. Mayok, Cremorne, N.S.W.; Eric Long, Leysin, Sur-Aigle, Switzerland; B. Osbourn, Rose Bay, Sydney, S. Australia; M. de Lima, Bombay, India; Jack Ibbotson, Goulburn, N.S.W.

A considerable number of Certificates of Merit have been awarded in addition to those listed.

The entry that succeeded in carrying off the First Prize was in the form of a large 4-6-0 locomotive and tender built by R. O. Jukes. Jukes, as many of our readers will remember, has carried off prizes in model-building contests on several previous occasions, and his latest entry is indeed a masterpiece. The engine has been christened by its builder "The Timaru" and the illustration on page 599 gives some idea of the fine appearance of the model. The letters on the tender stand for "New Zealand Meccano Railway."

Quite an unusual entry was submitted by W. Isbister. It is in the form of a lawn mower. The mower is built on a large scale and reproduces the actual machine with considerable accuracy. The model is fitted with a "free wheel" device by means of which the mower can be pulled backward without rotating the cutters. A model of this type could not be expected, of course, to actually "mow," but proof that the model is designed correctly is given by the fact that it can be made to lift into the "grass-box" small pieces of paper placed on the floor. Meccano boys who are in need of fresh ideas should try their hand at constructing models of this type.

The fact that we are at present living in what might be described as the Age of Motors is exemplified by the very large number of competitors in the recent model-building contests who have taken this branch of engineering for their subject. The predominance of motor vehicles in the entries has an unfortunate effect on the average Meccano motor builder, for unless he contrives to produce a model incorporating entirely new or outstanding features his chance of carrying off a large prize is minimised.



George Tedeschi has managed to reproduce a model of a motor tractor on quite interesting and ingenious lines, however. The most interesting features of the tractor are the clockwork mechanism ingeniously concealed in the bonnet, correct Jeantend steering gear, differential, and bucket seat. The complete model has a neat and realistic appearance and the efforts of the builder have been well repaid.

All our readers should be familiar with the amusing incident in the travels of Don Quixote and his faithful servant Sancho Panza, when Quixote, unable to arrest the motion of the sails of a windmill by ordering them to stop, finally attacks them with his lance! P. and R. Hastings evidently thought this famous incident worthy of reproduction in Meccano, and the splendid model that they have succeeded in building shows that they decided upon an excellent subject.

The model includes a windmill, with rotating sails, and Quixote himself mounted on a horse and carrying a lance. Sancho Panza also features in the scene and by waving his arms appears to be trying to restrain his master in his efforts to destroy the windmill! The operating mechanism of the model has been so arranged that whenever Don Quixote makes a "charge" at any particular sail of the windmill he always just manages to miss it!

The double-decker omnibus provides plenty of scope for the model-builder and many excellent representations of this class of vehicle have been submitted from time to time. The 'bus entered by Nelson Eustis is well designed and built up, and must appear very effective when propelled along by means of the Clockwork Motor which is enclosed in the bonnet of the 'bus.

Captain Campbell's famous record-breaking car "Bluebird" formed the subject of Norman B. Scott's entry, whose attempt at reproducing the car in miniature has been very successful.

A. A. Sutton sent in a very interesting model of a carpet sweeeper. His method of constructing the "brush" is worthy of mention. The foundation of the brush consists of a Meccano Wood Roller, round which is twisted a quantity of Meccano cord. Loops are made at regular intervals by doubling a short length of the cord and tying the doubled end in a "granny knot," the points of the loops protruding from the Roller. These loops are then cut, and the remaining ends form quite efficient "bristles."

"Christmas" Competition, Overseas Section

As in the "November" Contest, a very large number of remarkably interesting entries were received in the Overseas Section of the "Christmas" Competition. The names of the prize-winners are as follows:

FIRST PRIZE (Cheque to value £3-3s.): Philip and Carel Begemann, Semarang Java, Dutch East Indies. SECOND PRIZE (cheque to value £2-2s.): Charles C. Sweet, Banff, Alberta. THIRD PRIZE (cheque to value £1-1s.): E. Watkinson, Natal, South Africa.

TWELVE PRIZES, each consisting of Meccano products to the value of 5/-. Clarence Robinson, Otago, New Zealand; W. Sangers, Bergen, Holland; Frank Van Bulck, Paris; T. C. Walker, Westmount, Canada; C. J. Boeljon, Arnhem, Holland; A. M. Barber, Eagle Junction, Brisbane, Australia; Enzo Bernardini, Rovigo, Italy; John S. Coombs, Dunedin, New Zealand; F. C. Colley, Toronto, Canada; Edward Holder, San Fernando, Trinidad, B.W.I.; Geoffrey Keller, Taumarunui, New Zealand; A. Pilgrim, Leederville, Perth, Australia.

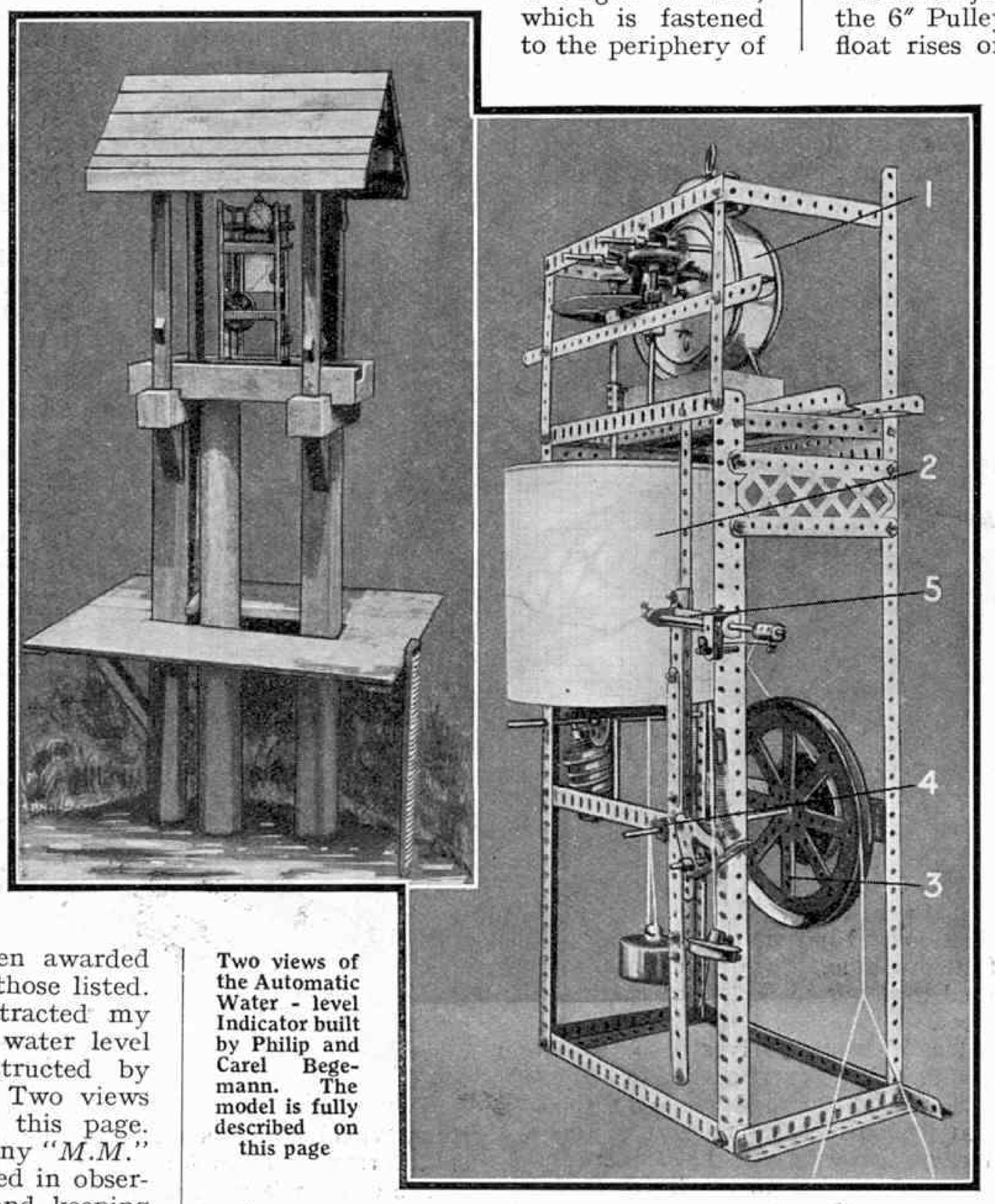
SPECIAL COMMENDATION (Certificates of Merit): E. G. Hannaford, Belair, Australia; H. C. van Doorn, Utrecht, Holland; Colin R. Glen, Killara, Sydney, N.S.W.; F. Blundy, Melbourne, Victoria; R. B. White, Wayvill, South Australia; Edwin Worthington, South Vancouver, British Columbia; James F. Stenhouse, Otago, New Zealand; F. G. Glass, Pernambuco, Brazil; W. F. Rogers, Ashfield, Sydney, Australia; P. J. Cox, Adelaide, Australia; L. Fisher, Johannesburg, South Africa; S. Budge, Guernsey, C.I.; G. Morgan, Wellington, New Zealand; Nelson Eustis, Alberton, Australia; N. Grant, Pretoria, Africa; J. D. Wilson, Johannesburg, Africa.

A considerable number of Certificates of Merit have been awarded to competitors in addition to those listed.

An entry that at once attracted my attention was the automatic water level indicator designed and constructed by Philip and Carel Begemann. Two views of the model are shown on this page. Instruments of this type, as many *"M.M."* readers will know, are employed in observatories for measuring tides and keeping continuous records of the fluctuations in depth of rivers, canals, lakes, etc. They also prove useful while artificial dams are under construction, as the instruments will give warning automatically to the engineers when the water level rises above the safety mark.

The Meccano model operates as follows: the circular drum 2, which consists of a sheet of stiff cardboard fastened over two 6" Pulley Wheels, is rotated slowly by means of the alarm clock 1. The drive is taken from the winding key of the clock. Between the key spindle of the clock and the shaft carrying the drum, reduction gear is fitted so that the drum rotates once every five hours, but the gearing may be arranged, of course, so that the rotation of the drum is spread over a longer or shorter period.

The lower half of the instrument is devoted to the mechanism that alters the position of the pencil on the surface of the drum. This mechanism consists of a length of wire, which is fastened to the periphery of the 6" Pulley Wheel 3 and has attached to its other end an airtight tin that forms the "float." This float is suitably weighted and moves in an iron tube placed with one end in the water. From the illustrations it may be seen that the apparatus has been fitted over a "water-hole." These "water-holes" are indigenuous to tropical countries and as they are in reality a tributary from a river, variations in their depth indicate any changes that may be taking place in the depth of the actual river.



Two views of the Automatic Water - level Indicator built by Philip and Carel Begemann. The model is fully described on this page

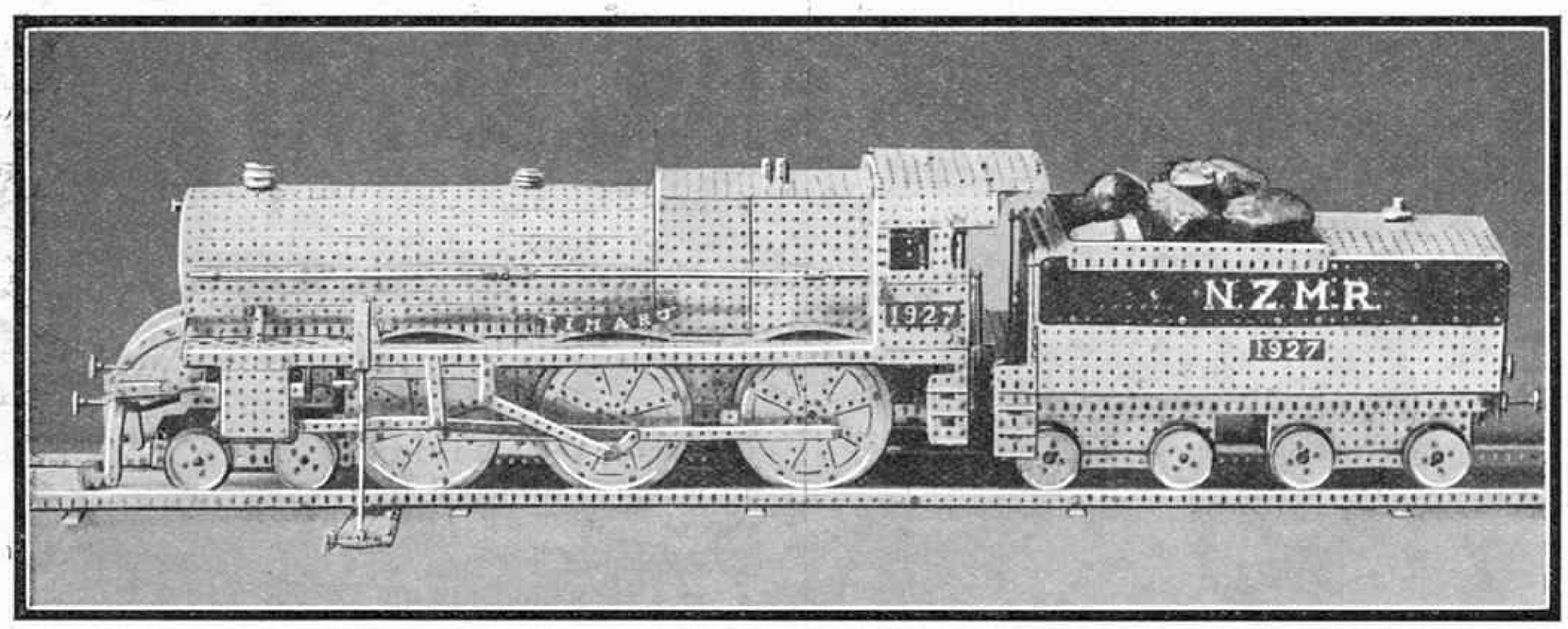
The shaft carrying the Pulley Wheel 3 also carries a 2" Pulley Wheel about which is wound a cord with weight attached. The latter just balances the float and keeps the 6" Pulley Wheel 3 steady. When the float rises or falls, however, the Wheel 3 is rotated. This causes the ½" Pinion 4 to move the Rack Strips up or down, and as the pencil 5 is attached to the Rack Strips, its position is altered with respect to the rotating drum 2. Thus the variance in depth of the water is recorded automatically. In the second illustration of this model, the pencil may be seen tracing an undulating line on the drum. This line corresponds, of course, with the gradual rise and fall of the river. I congratulate both Philip and Carel on their excellent model.

A particularly fine reproduction of a railway breakdown crane was entered by C. C. Sweet, who secured Second Prize. The illustration on the opposite page brings out most of the features of the model and by referring to it readers will note the principal constructional details. Breakdown cranes form excellent subjects for Meccano models, and Sweet's entry is certainly a most pleasing piece of constructional work.

By a curious coincidence, prize-winners in both this and the "November" Contest, the results of which appear opposite, submitted as their entries models of lawn-mowers. I have mentioned previously W. Isbister's entry and I feel sure that if both models had been entered in the same contest they would certainly have tied, as it would be extremely difficult to decide which was the better of the two. E. Watkinson's lawn-mower possesses several very interesting features.

Another prize-winning entry that is worthy of particular mention is the splendid model of H.M.S. Hood sent in by Clarence Robinson. To give some idea of the size and amount of detail incorporated in the model, it is only necessary to say that 1,300 nuts and bolts were used in building it! The

(*Cont. on page* 618)



The "Timaru," a locomotive in use on the New Zealand Meccano Railway. It is the work of R. O. Jukes

New Meccano Models

Rope Making Machine—Coaster—Drill—Steam Shovel—Windmill—Steam Engine

THE wire-rope making machine shown in Fig. 1 is a very interesting model to build and use. When it is set in motion four separate threads of wire are twisted together to form a single cable, which, incidentally, will be very useful in connection with Meccano constructional work. The threads of wire should, of course, be very thin and pliable. If desired thin string or thread may be used in place of the wires.

The 5½″×2½″ Flanged Plates at the front end of the model are joined at the top by 5½″ Angle Girders, to which Trunnions are bolted. These Trunnions form bearings for an Axle Rod 3 that carries the following components; a 1″ Sprocket Wheel, two Couplings 2, a Face Plate, 1½″ Pulley Wheel and a Bush Wheel. The Couplings 2 are secured at right angles to each other and each carries two 2″ Rods secured in its ends.

These 2″ Rods provide bearings for four bobbins 1, each of which consists of two ¾″ Flanged Wheels butted together. The set-screws of the Flanged Wheels are removed so that the bobbins are free to rotate about the 2″ Rods. The wires from the bobbins pass through holes in the Face Plate and in the 1½″ Pulley Wheel and Bush Wheel and are tied together on a drum at the opposite end of the machine. The drum consists of two 3″ Pulley Wheels connected together by 2½″ small radius Curved Strips and Angle Brackets.

On rotation of the hand wheel a ½″ Pinion drives a 57-teeth Gear Wheel secured to the Rod 7. This Rod 7 carries a 2″ Sprocket Wheel that is connected by chain to the 1″ Sprocket Wheel on the shaft 3 of the bobbins. The Rod 7 also imparts motion to the drum by means of a ½″ Pinion engaging with the 1½″ Contrate Wheel on the Rod 4. Motion is transmitted from the latter Rod to the drum shaft by means of Sprocket Wheels and chain. As the bobbins 1 are rotated the wires are twisted together between the Pulley Wheel 5 and the drum, and are wound on the latter in the form of a cable. In order to prevent the wire from unwinding too rapidly, Washers are placed on the 2″ Rods between the Couplings and the bosses of the Flanged Wheels 1, and the Collars 6 are pressed hard against the wheels before being secured to the 2″ Rods. This produces a frictional retarding effect.

A considerable amount of tension is essential to the production of good wire rope, and for this reason the 1½″ Pulley Wheel 5 and the Bush Wheel behind it are secured close together on the Rod 3 in such a manner that the friction generated by the wires in passing through the holes in the wheels keeps the cable taut while it is being twisted.

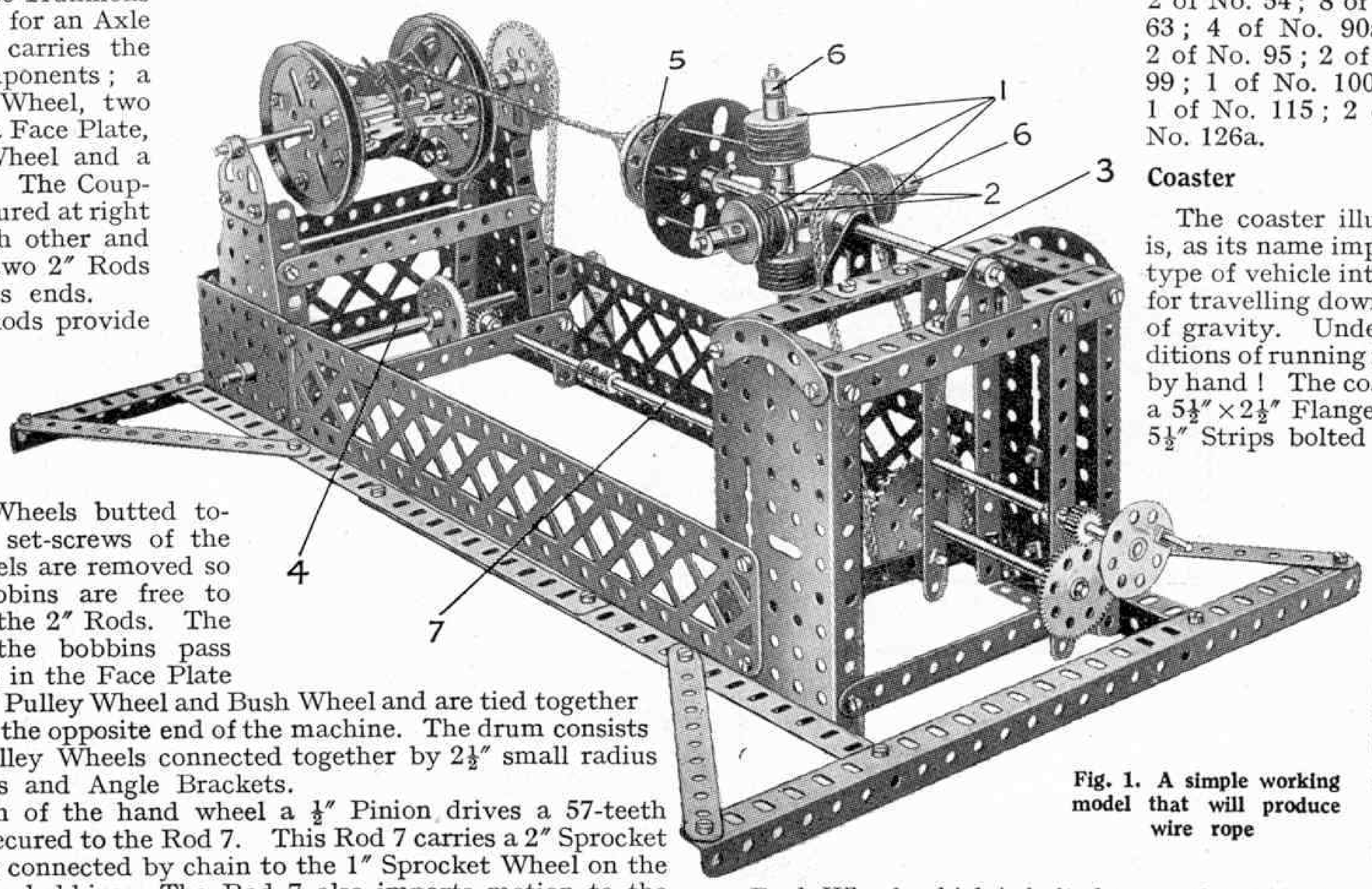


Fig. 1. A simple working model that will produce wire rope

Parts required to build the Meccano wire-rope making machine are as follows:—11 of No. 2; 6 of No. 8; 2 of No. 9; 8 of No. 12; 1 of No. 13; 1 of No. 13a; 2 of No. 14; 1 of No. 15a; 1 of No. 16; 4 of No. 17; 2 of No. 19b; 8 of No. 20; 1 of No. 21; 1 of No. 24; 2 of No. 26; 1 of No. 27a; 1 of No. 28; 84 of No. 37; 2 of No. 52; 2 of No. 54; 8 of No. 59; 3 of No. 63; 4 of No. 90a; 1 of No. 94; 2 of No. 95; 2 of No. 96; 2 of No. 99; 1 of No. 100; 1 of No. 109; 1 of No. 115; 2 of No. 126; 2 of No. 126a.

Coaster

The coaster illustrated in Fig. 2 is, as its name implies, a model of a type of vehicle intended principally for travelling down-hill by the force of gravity. Under any other conditions of running it must be pushed by hand! The coaster is built from a 5½″×2½″ Flanged Plate with two 5½″ Strips bolted to its underside. At the outer ends of these Strips a 2½″×½″ Double Angle Strip is bolted and a second Strip of the same kind is secured to the ends of the first in the manner shown. A 2″ Rod journalled in these two Double Angle Strips is secured at its lower end to a Bush Wheel, which is bolted to another 2½″×½″ Double Angle Strip that forms bearings for the front axle.

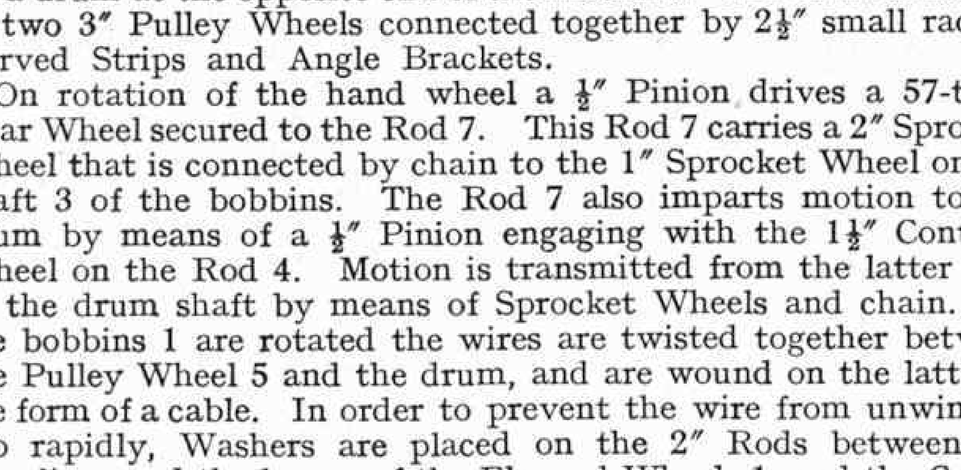


Fig. 2. The Meccano Coaster—an economical method of transport!

The coaster is steered by means of two hand levers pivoted at their lower ends to the Flanged Plate by means of bolts and nuts (see Standard Mechanism No. 262). Connection is made between these levers and the extremities of the front axle by means of short lengths of cord tied to the centres of the levers and to Flat Brackets placed on the front axle between the Double Angle Strip and the bosses of the 3″ Wheels.

The parts necessary to build the coaster are: 2 of No. 2; 2 of No. 5; 4 of No. 10; 2 of No. 16; 1 of No. 18a; 4 of No. 19b; 1 of No. 22; 1 of No. 24; 22 of No. 37; 2 of No. 37a; 6 of No. 38; 4 of No. 48a; 1 of No. 52; 2 of No. 126a.

Drilling Machine

The base of the drilling machine (Fig. 3) consists of a Sector Plate, to which is attached by means of an Angle Bracket and a Trunnion a 5½″×2½″ Flanged Plate. The bearings for the drill

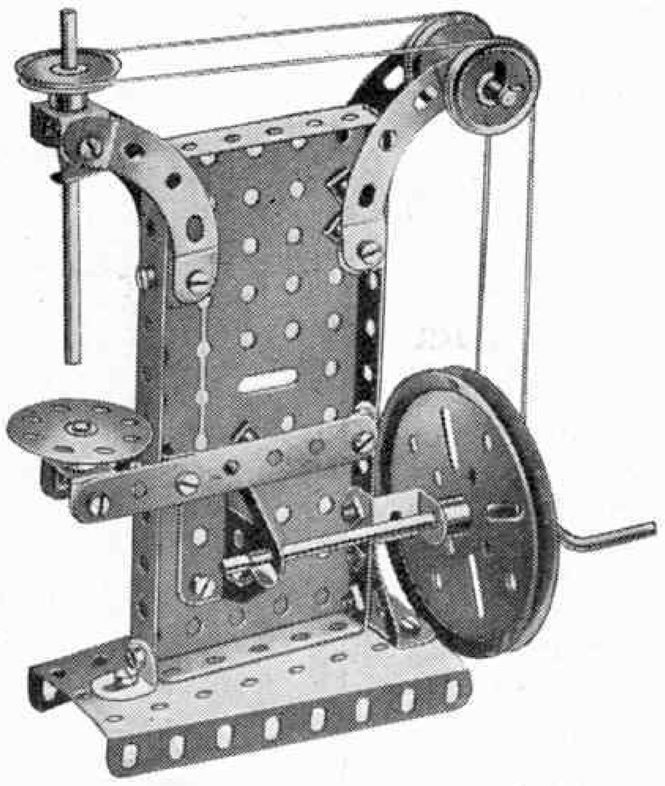


Fig. 3. Drilling Machine

shaft and the Rod carrying the guide Pulleys consist of 2½″ small radius Curved Strips fastened together at their outer ends by Double Brackets. These Strips are bolted on one side direct to the Flanged Plate and on the other side to Angle Brackets that are secured to the flanges of the Plate as shown. The drill is represented by a 3½″ Axle Rod journalled in the Double Bracket and an Angle Bracket bolted to one pair of Curved Strips.

An endless cord is passed round the Pulley Wheel at the top of the drill shaft and is led over the two 1″ Pulley Wheels that act as guides and then round another 1″ Pulley Wheel fastened to the Crank Handle. One of the guide Pulleys should be secured to its Rod and the other must be free to rotate about the Rod, since they are required to revolve in opposite directions. The Crank Handle carries a 3″ Pulley, which acts as a flywheel, and is journalled in a Reversed Angle Bracket and a Trunnion attached to the Flanged Plate. The drill table consists of a Bush Wheel that is fastened to a Double Bracket by means of a ⅜″ Bolt. The latter is pushed through the centre hole of the Bracket and is gripped in the boss of the Bush Wheel.

The parts required for this model are : 1 of No. 3 ; 2 of No. 11 ; 6 of No. 12 ; 1 of No. 16 ; 1 of No. 18a ; 1 of No. 19b ; 1 of No. 19s ; 4 of No. 22 ; 1 of No. 24 ; 2 of No. 35 ; 27 of No. 37 ; 1 of No. 52 ; 1 of No. 54 ; 4 of No. 90a ; 1 of No. 125 ; 2 of No. 126.

Steam Shovel

Meccano boys who possess small Outfits always take a pride in producing with a few parts models of elaborate or complicated machinery. The Steam Shovel illustrated in Fig. 4 is an example of this kind of construction. The assembly of the model is simplicity itself.

The Sector Plate is fastened to the 5½″ × 2½″ Flanged Plate by means of a ⅜″ Bolt passed through the two Plates and held in place by means of Tock nuts (see Standard Mechanism No. 263). To ensure smooth rotation of the Sector Plate about its pivot a Washer should be placed on the bolt between the Flanged Plate and the Sector Plate. The shovel arm has a Double Bracket attached near its upper end, and a 2″ Rod that forms the pivot of the arm is passed through this Double Bracket and through the fixed jib of the model.

When at work the model is run up to the heap of material that is to be removed, the shovel being lowered simultaneously. The Crank Handle is then rotated, causing the shovel to scoop up a quantity of material. The Sector Plate may then be turned about its pivot and the load dumped in a waiting wagon.

The steam shovel is composed of the following parts : 5 of No. 2 ; 1 of No. 11 ; 1 of No. 12 ; 2 of No. 16 ; 2 of No. 18a ; 1 of No. 19s ; 4 of No. 22 ; 1 of No. 23 ; 6 of No. 35 ; 12 of No. 37 ; 2 of No. 37a ; 2 of No. 38 ; 1 of No. 52 ; 1 of No. 54 ; 1 of No. 111c ; 1 of No. 126 ; 2 of No. 126a.

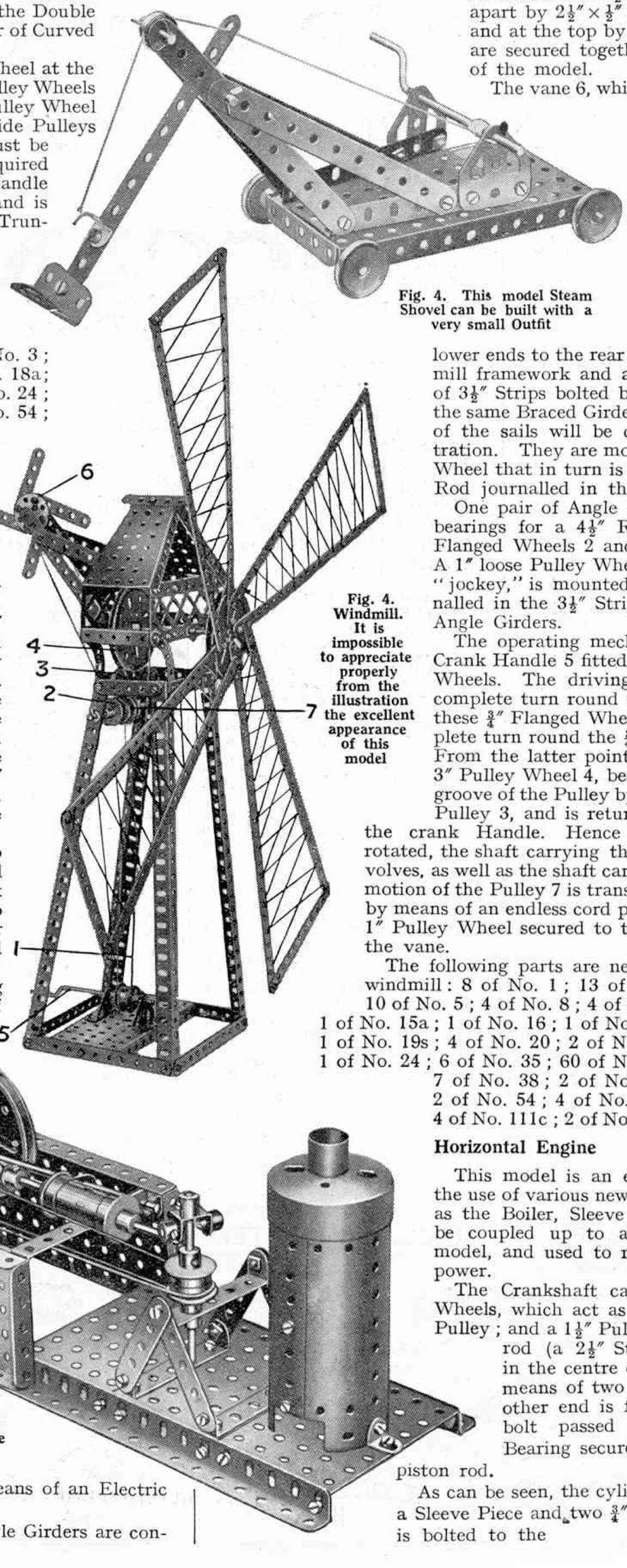


Fig. 4. Windmill. It is impossible to appreciate properly from the illustration the excellent appearance of this model

Windmill

Models of windmills are always popular with Meccano boys and no doubt many "*M.M.*" readers will have admired large structures of this kind in motion. The model shown in Fig. 5 is of very graceful appearance and the effect produced when it is in operation is most pleasing. Interest will be added if the sails are arranged to rotate slowly and smoothly by means of an Electric or Clockwork Motor.

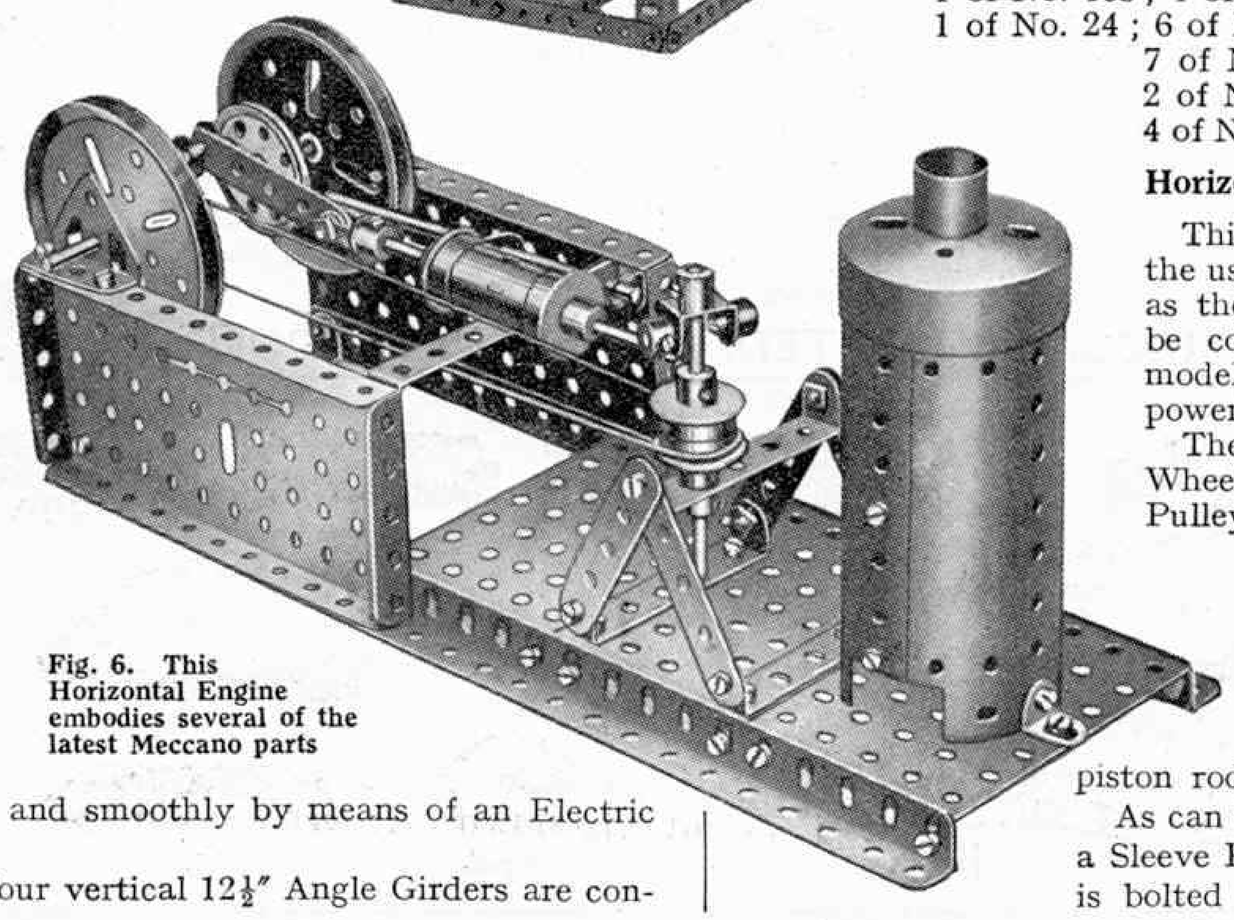


Fig. 6. This Horizontal Engine embodies several of the latest Meccano parts

The upper ends of the four vertical 12½″ Angle Girders are connected together at the front and back by 3½″ Strips and at the sides by 2½″ Strips. The bolts that secure the 3½″ Strips are used also to fasten four 2½″ small radius Curved Strips. These Curved Strips support the upper framework of the mill. This framework consists of two 5½″ Braced Girders held apart by 2½″ × ½″ Double Angle Strips and at the top by Sector Plates, which are secured together to form the roof of the model.

Fig. 4. This model Steam Shovel can be built with a very small Outfit

The vane 6, which in an actual windmill is used to keep the sails always to the wind, consists of four 2½″ Strips bolted to a Bush Wheel in the positions indicated. The complete vane is mounted on a 1½″ Axle Rod that is journalled in 5½″ Strips. These are attached at their lower ends to the rear Braced Girder of the mill framework and are braced by means of 3½″ Strips bolted by Angle Brackets to the same Braced Girder. The construction of the sails will be clear from the illustration. They are mounted on a 3″ Pulley Wheel that in turn is secured to a 5″ Axle Rod journalled in the Braced Girder.

One pair of Angle Girders form journal bearings for a 4½″ Rod carrying two ¾″ Flanged Wheels 2 and a 1″ fast Pulley 7. A 1″ loose Pulley Wheel 3, which acts as a "jockey," is mounted on a 3½″ Rod journalled in the 3½″ Strips at the top of the Angle Girders.

The operating mechanism consists of a Crank Handle 5 fitted with two ¾″ Flanged Wheels. The driving cord 1 is given a complete turn round the drum formed by these ¾″ Flanged Wheels and another complete turn round the ¾″ Flanged Wheels 2. From the latter point it passes round the 3″ Pulley Wheel 4, being guided round the groove of the Pulley by means of the jockey Pulley 3, and is returned to the drum on the crank Handle. Hence as the Handle is rotated, the shaft carrying the Pulley Wheel 7 revolves, as well as the shaft carrying the sails. The motion of the Pulley 7 is transmitted to the vane 6 by means of an endless cord passing round another 1″ Pulley Wheel secured to the 1½″ Rod carrying the vane.

The following parts are necessary to build the windmill : 8 of No. 1 ; 13 of No. 2 ; 2 of No. 3 ; 10 of No. 5 ; 4 of No. 8 ; 4 of No. 12 ; 1 of No. 15 ; 1 of No. 15a ; 1 of No. 16 ; 1 of No. 18a ; 2 of No. 19b ; 1 of No. 19s ; 4 of No. 20 ; 2 of No. 22 ; 1 of No. 22a ; 1 of No. 24 ; 6 of No. 35 ; 60 of No. 37 ; 4 of No. 37a ; 7 of No. 38 ; 2 of No. 48a ; 1 of No. 52 ; 2 of No. 54 ; 4 of No. 90a ; 2 of No. 100 ; 4 of No. 111c ; 2 of No. 126.

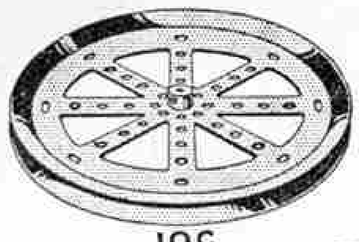
Horizontal Engine

This model is an excellent example of the use of various new Meccano parts, such as the Boiler, Sleeve Piece, etc. It may be coupled up to almost any Meccano model, and used to represent the driving power.

The Crankshaft carries two 3″ Pulley Wheels, which act as flywheels ; a 1″ fast Pulley ; and a 1½″ Pulley. The connecting rod (a 2½″ Strip) is held in place in the centre of the Crankshaft by means of two Spring Clips and its other end is free to turn about a bolt passed through the End Bearing secured to the end of the piston rod.

As can be seen, the cylinder is built up from a Sleeve Piece and two ¾″ Flanged Wheels and is bolted to the

(*Continued on page* 610)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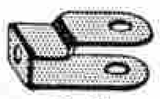
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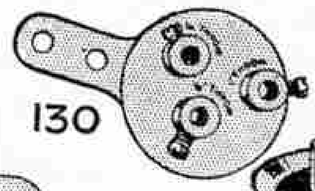
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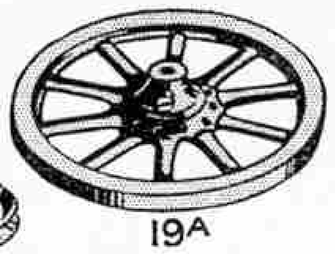
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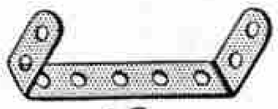
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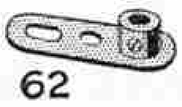
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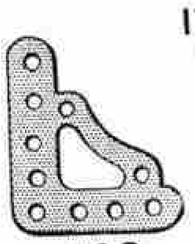
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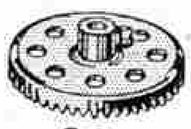
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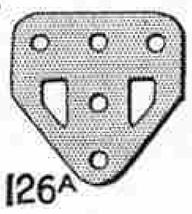
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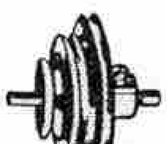
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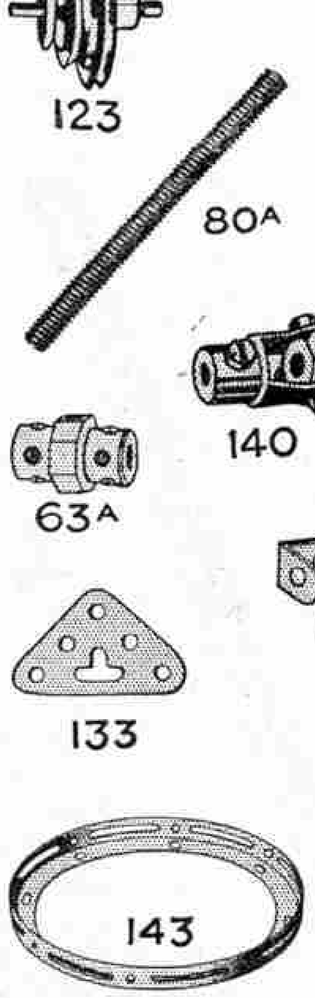
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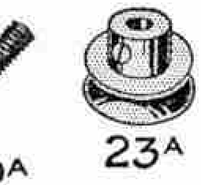
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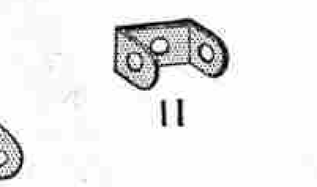
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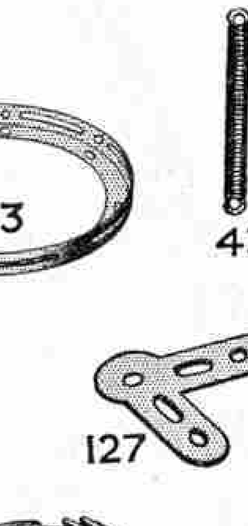
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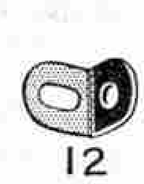
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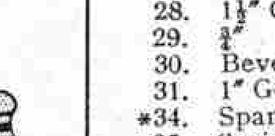
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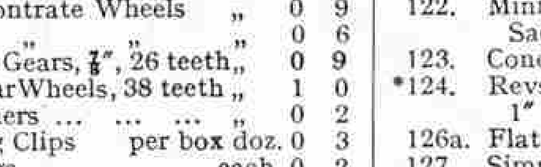
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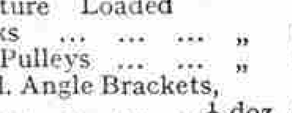
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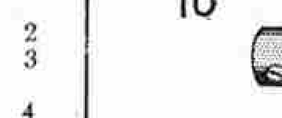
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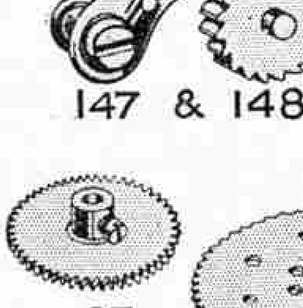
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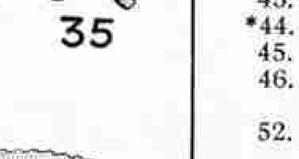
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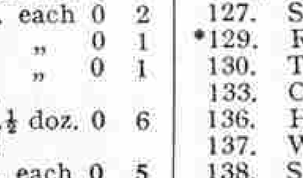
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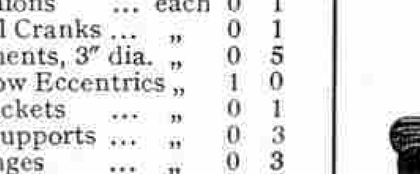
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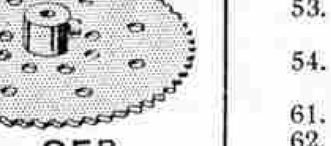
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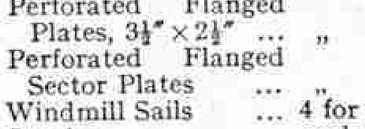
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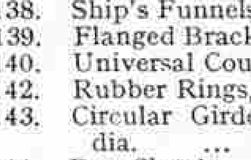
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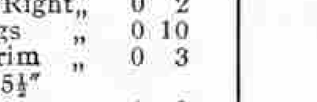
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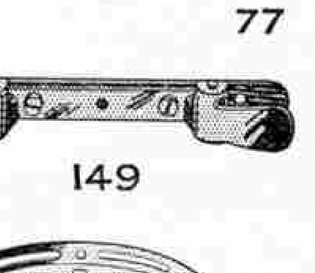
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MECCANO

Accessory Parts

THE Meccano system is composed of some two hundred and fifty real engineering parts, mostly made of steel or brass, each one of which has a specified mechanical purpose. These parts combine to form a complete miniature engineering system, enabling practically any movement known in mechanics to be duplicated.

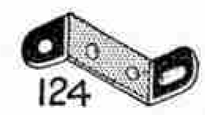
We illustrate a selection of accessory parts that every Meccano boy will find useful in building the larger and more interesting models. Ask your dealer for a copy of the complete illustrated list of Meccano Accessory Parts, and keep it by you for reference.

No.			s.	d.
9b.	Angle Girders, 3½" long	½ doz.	0	8
*10.	Flat Brackets	„	0	2
*11.	Double Brackets ...	each	0	1
*12.	Angle Brackets, ½" × ½"	doz.	0	3
17.	Axle Rods, 2"	3 for	0	1
19a.	Wheels, 3" with set screw	each	0	6
	Pulley Wheels			
19c.	6" dia. with centre boss and set screw	„	2	0
22.	1" „ „	„	0	3
22a.	1" without set screw	„	0	2
23a.	½" „ „	„	0	3
26.	Pinion Wheels, ½" diam.	„	0	4
27.	Gear Wheels, 50 teeth	„	0	6
27a.	„ „ 57 „	„	0	6
28.	1½" Contrate Wheels	„	0	9
29.	¾" „ „	„	0	6
30.	Bevel Gears, ⅞", 26 teeth	„	0	9
31.	1" Gear Wheels, 38 teeth	„	1	0
*34.	Spanners	„	0	2
35.	Spring Clips	per box	0	3
43.	Springs	each	0	2
*44.	Cranked Bent Strips	„	0	1
45.	Double Bent Strips	„	0	1
46.	Double Angle Strips, 2½" × 1"	½ doz.	0	6
52.	Perforated Flanged Plates, 5½" × 2½" ...	each	0	5
53.	Perforated Flanged Plates, 3½" × 2½" ...	„	0	3
54.	Perforated Flanged Sector Plates ...	„	0	3
61.	Windmill Sails ...	4 for	0	6
62.	Cranks	each	0	3
63a.	Octagonal Couplings	„	0	8
72.	Flat Plates, 2½" × 2½"	„	0	2
77.	Triangular Plates, 1"	„	0	1
80a.	Screwed Rods, 3½" ...	„	0	3
90.	Curved Strips, 2½", large radius	„	0	1
90a.	Curved Strips, 2½", small radius	„	0	1

No.			s.	d.
94.	Sprocket Chain	per length	0	6
*95b.	Sprocket Wheels, 3" dia.	each	0	6
*96	„ „ 1" „	„	0	3
99.	Braced Girders, 12½"	„ ½ doz.	2	6
103d.	Flat Girders, 3½" ...	„	0	7
*104.	Shuttles, for Looms	each	7	6
106a.	Sand Rollers	„	1	9
108.	Architraves	„	0	2
109.	Face Plates, 2½" dia.	„	0	4
*114.	Hinges	per pair	0	4
*116.	Fork Pieces	each	0	3
118.	Hub Discs, 5½" dia.	„	1	3
119.	Channel Segments (8 to circle), 11½" dia.	„	0	4
122.	Miniature Loaded Sacks	„	0	2
123.	Cone Pulleys	„	1	3
*124.	Revsd. Angle Brackets, 1"	½ doz.	0	4
126a.	Flat Trunnions ...	each	0	1
127.	Simple Bell Cranks ...	„	0	1
*129.	Rack Segments, 3" dia.	„	0	5
130.	Triple Throw Eccentrics	„	1	0
133.	Corner Brackets ...	„	0	1
136.	Handrail Supports ...	„	0	3
137.	Wheel Flanges ...	„	0	3
138.	Ship's Funnels ...	„	0	3
139.	Flanged Brackets, Right	„	0	2
140.	Universal Couplings	„	0	10
142.	Rubber Rings, 3" rim	„	0	3
143.	Circular Girders, 5½" dia.	„	1	0
144.	Dog Clutch	„	0	6
145.	Circular Strips, 7" dia. overall	„	0	9
146.	Circular Plates, 6" dia.	„	1	0
*147.	Pawls, with pivot bolt and nuts	„	0	3
148.	Ratchet Wheels ...	„	0	6
149.	Collecting Shoes, for Electric Locos ...	„	1	6

*These parts are supplied with nickel finish only.

MECCANO LIMITED, Binns Rd., LIVERPOOL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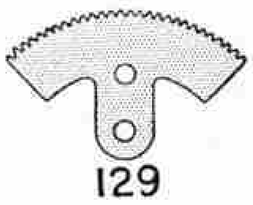
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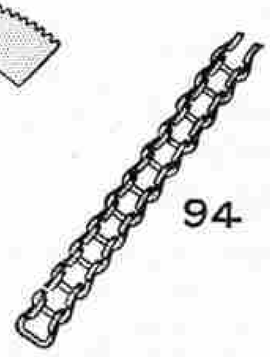
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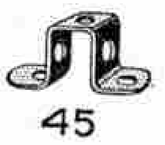
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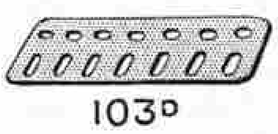
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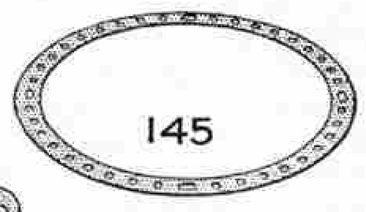
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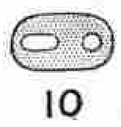
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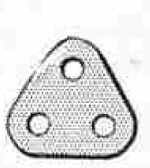
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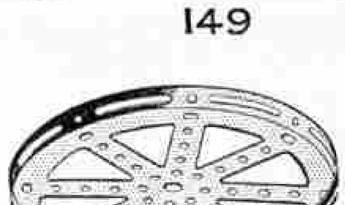
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What is Wrong with this Crane?

A Splendid Test for Sharp-eyed Model-Builders

EVERY BOY SHOULD ENTER THIS NOVEL CONTEST

IN building models on real engineering lines, the Meccano boy constantly is acquiring for himself invaluable knowledge and experience that will be of very great use to him in later life. This month's Contest is designed to form an entirely fresh kind of test by which we can gauge the soundness of the principles by which Meccano boys work, and we feel sure that it will be welcomed by all *"M.M."* readers who pride themselves on being proficient in the art of building models according to correct engineering practice.

The subject of the contest is the derrick crane illustrated below. The model has been purposely constructed incorrectly, and it will be seen that it is literally "bristling" with faults. We want all Meccano boys to make a list of these faults and send it in with their own opinions as to the way in which the construction of the model should be corrected.

In looking over the model it will be found that two definite types of mistakes have been made in building the derrick. The first type that will be found is the incorrect use of Meccano parts. For example, ¾" Bolts are used where the standard bolts would do quite well. Of course, it is assumed that the builder had the proper parts available when he constructed the derrick illustrated.

The second type of error concerns the design of the model. Errors of this type should be fairly obvious to keen Meccano boys, but it may help competitors to discover them if they study models of derrick cranes illustrated in the Manuals and other Meccano publications, for it will be found that models illustrated therein are built as far as possible on correct engineering lines.

Having noted the errors, it should be a fairly simple matter for competitors to explain how the model should be built. In this connection the Manuals should again prove useful, and a book that will also be of great help is the Meccano Standard Mechanisms Manual (price 1/1½ post free), for in it are to be found many Meccano movements designed on correct engineering lines. Some of these movements are particularly applicable to model cranes or derricks.

THE PRIZES

Prizes in Sections A and C are as follows :—

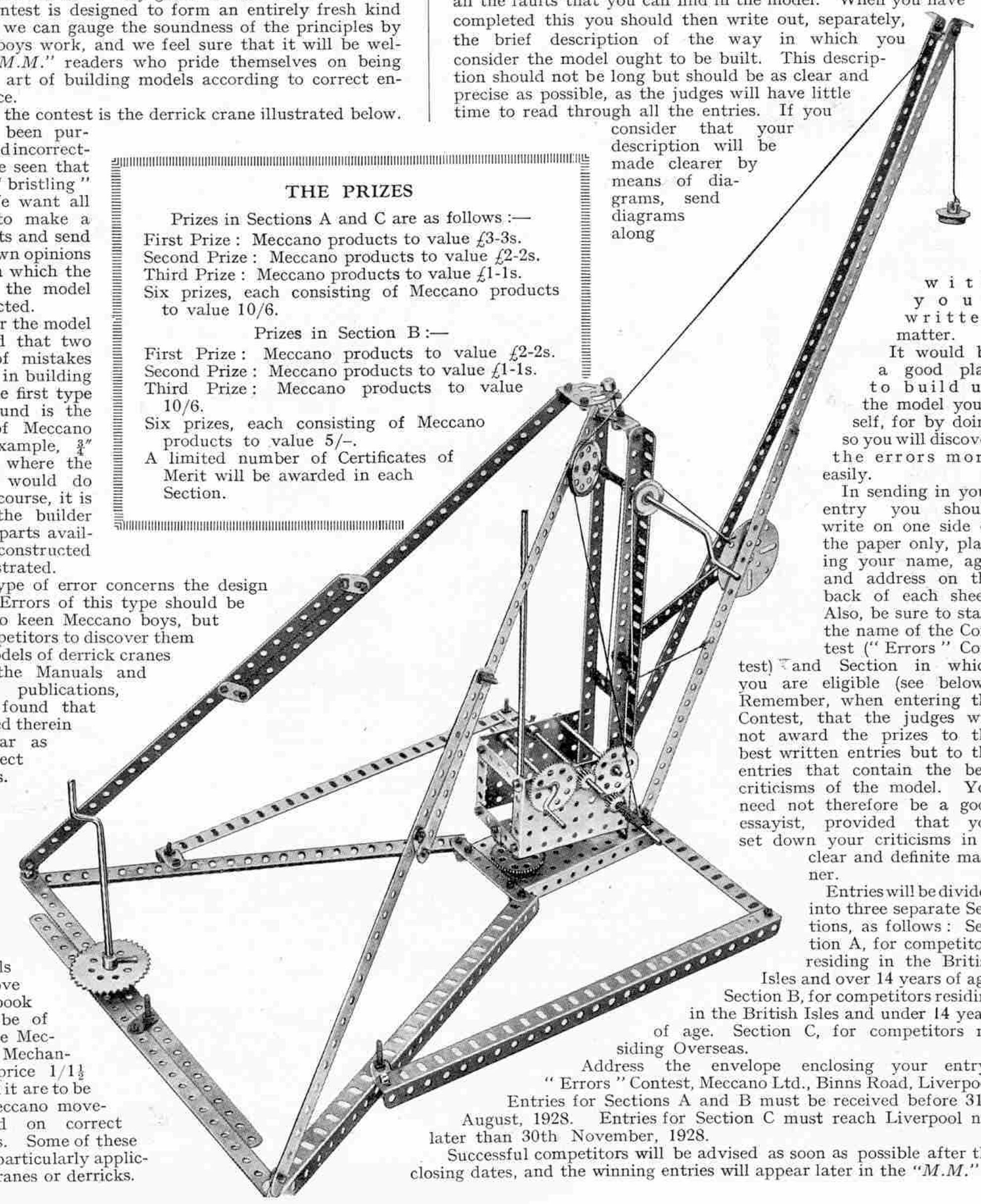
First Prize : Meccano products to value £3-3s.
Second Prize : Meccano products to value £2-2s.
Third Prize : Meccano products to value £1-1s.
Six prizes, each consisting of Meccano products to value 10/6.

Prizes in Section B :—

First Prize : Meccano products to value £2-2s.
Second Prize : Meccano products to value £1-1s.
Third Prize : Meccano products to value 10/6.
Six prizes, each consisting of Meccano products to value 5/–.
A limited number of Certificates of Merit will be awarded in each Section.

How to Enter

In entering the contest you should first write out the list of all the faults that you can find in the model. When you have completed this you should then write out, separately, the brief description of the way in which you consider the model ought to be built. This description should not be long but should be as clear and precise as possible, as the judges will have little time to read through all the entries. If you consider that your description will be made clearer by means of diagrams, send diagrams along with your written matter. It would be a good plan to build up the model yourself, for by doing so you will discover the errors more easily.

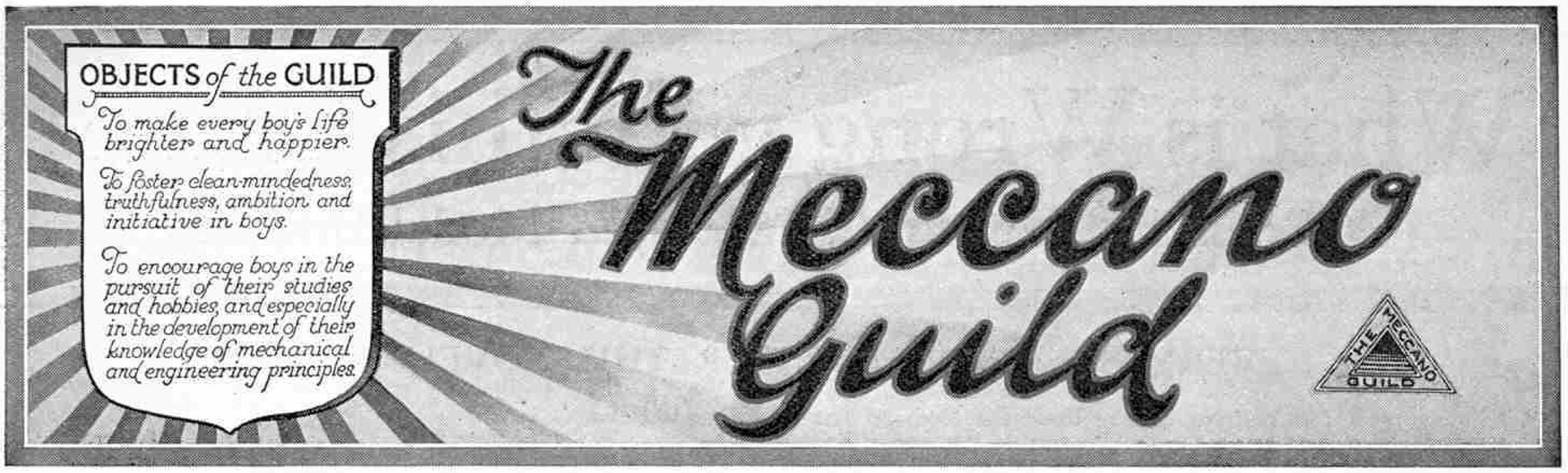


In sending in your entry you should write on one side of the paper only, placing your name, age, and address on the back of each sheet. Also, be sure to state the name of the Contest ("Errors" Contest) and Section in which you are eligible (see below). Remember, when entering the Contest, that the judges will not award the prizes to the best written entries but to the entries that contain the best criticisms of the model. You need not therefore be a good essayist, provided that you set down your criticisms in a clear and definite manner.

Entries will be divided into three separate Sections, as follows : Section A, for competitors residing in the British Isles and over 14 years of age. Section B, for competitors residing in the British Isles and under 14 years of age. Section C, for competitors residing Overseas.

Address the envelope enclosing your entry : "Errors" Contest, Meccano Ltd., Binns Road, Liverpool. Entries for Sections A and B must be received before 31st August, 1928. Entries for Section C must reach Liverpool not later than 30th November, 1928.

Successful competitors will be advised as soon as possible after the closing dates, and the winning entries will appear later in the *"M.M."*



With the Secretary

Hunting Hidden Treasure

By this time the majority of clubs are well ahead with their summer programme, having to a large extent transferred their activities from the club room to the open air. I find that the Leaders of some small clubs are finding difficulty in keeping in touch with their members, particularly during the period of the school holidays. In certain cases of this kind I believe it is advisable not to attempt to carry out a full programme but to arrange two or three special events of sufficient attractiveness to tempt the majority of the members to turn up. The nature of these special events must, of course, depend to a large extent on local conditions and circumstances, but as a rule a whole-day picnic to some place of interest or a visit to some local engineering works or factory may be relied upon to succeed.

Another interesting scheme for such an occasion is a treasure hunt. This has been tried by several clubs with such success as to make it a regular feature of the programme. In order to assist any Leaders who may care to try the idea I give the following outline of the method to be adopted.

The "treasure"—actually consisting of a certain number of pennies in a cloth bag—is imagined to be a large hoard of Spanish doubloons buried long ago by a retired pirate who, in the orthodox manner, drew a map of the place in which he had concealed it. As the result of a remarkable chain of circumstances this map came into the possession of the Leader of the club who, in the spirit of true comradeship, did not attempt to find the treasure himself but passed on the information to all his members. Thus the treasure hunt began.

The members of the club were paired off, the youngest with the oldest, and so on, in order to give all an equal chance, and each pair was supplied with a copy of the map. Puzzling out the antique forms of the names of familiar places, and filling in as best they could the gaps that occurred between the various clues, the winning pair finally reached the spot indicated and divided the doubloons between them. A Treasure Hunt on these lines should prove very popular, as it is both an exercise in ingenuity and a pleasant form of outdoor recreation.

An Interesting Summer Hobby

Another very interesting and instructive pursuit for the summer months that can be well recommended is flag signalling. Communication over a distance is always very attractive, whatever the means adopted, as is shown by the popularity of model telegraphic outfits such as that described in the series on "Electricity applied to Meccano" now running in the "*M.M.*," and "flag-wagging" is no exception to this general rule.

Two codes are used in flag-signalling. One is the Morse code used in ordinary telegraphy and the other is the semaphore code, which is much the more interesting. In the semaphore code the letters and numbers are represented by holding the flags at arm's length in various positions, one arm only being used for the letters from A to G and both for the remaining letters. In addition, it is necessary to be familiar with a few signs with special meanings, such as the calling up signal, V.E., or the end of message signal, A.R.

It is by no means difficult to learn this code. The various letters and numbers are illustrated in many books, including Scout Manuals, and a good plan is to mark them in tabular form on a piece of cardboard of pocket size. Secretaries of clubs possessing a hectograph or similar duplicating apparatus will be able to prepare a considerable number of these in a very short time. By reference to the cards at odd moments the signals may be memorised very quickly, and practice in reading and despatching is then required in order to produce the necessary speed and accuracy.

If a club has an experienced signaller in its ranks, the remaining members will acquire the necessary skill more quickly, but in any case steady practice will bring about this result. The first trials may be made in a room, but as soon as the members have acquired sufficient knowledge of the code, proceedings should be transferred to the open air and the communicating parties stationed at distances too great for speaking or shouting, so that all conversation must of necessity be carried out by means of the flags.

An interesting competition may be arranged in which small prizes should be offered. Ability in despatching and receiving should be tested and the prizes awarded to those who make the least number of mistakes in dealing with test messages that are unknown to the competitors until the moment of trial. In addition, style in despatching should be taken into account in order to encourage crisp and definite action on the part of the signaller.

Meccano Club Leaders

No. 35. Dr. T. Killen

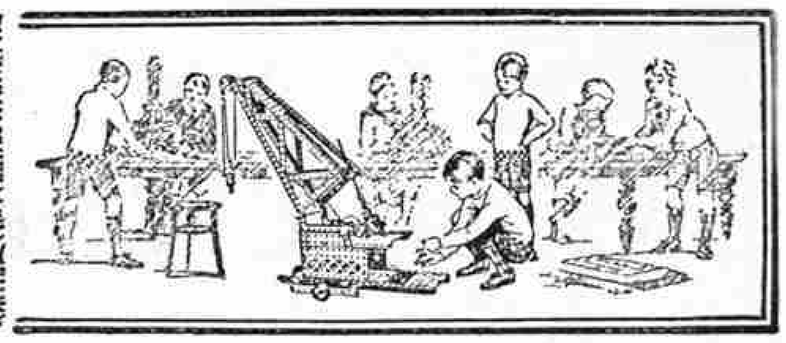
Dr. Killen has been Leader of the Larne Meccano Club since this was affiliated last year and through his skilful guidance the club has become thoroughly established on a sound basis. The photograph we published on page 441 of the May "M.M." shows that the club are fortunate in the possession of a thoroughly good meeting room. In addition to this, Dr. Killen has erected a splendid workshop for the use of members, and this is very keenly appreciated.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested should communicate with the promoters, whose names and addresses are given below.

AUSTRALIA.—C. A. Cartwright, Young Hill, Temora, Australia.
AUSTRALIA.—Herbert Cook, 41, Annesley Street, Leichhardt, Sydney, N.S.W., Australia.
MELROSE.—Ian C. Brewer, St. Mary's, Melrose, Scotland.
SEVENOAKS.—Keith Black, Halstead Place, Nr. Sevenoaks, Kent.
SWINDON.—C. Telling, Nr. The Church, Upper Minety, Nr. Swindon, Wilts.

CLUB NOTES



Albert Village M.C.—The club roll shows a decided increase, a very successful exhibition having helped greatly in this respect. A Motor Chassis model recently loaned from Headquarters proved a great attraction at this display, and among other splendid models was a Meccano Fair completely equipped with swings, roundabouts and side shows of all kinds. The programme for the summer session includes Photography, Natural History Excursions and Cricket. An interesting feature is that the club has been requested to take part in a local Exhibition. Club roll: 16. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Burton-on-Trent.

Upwey and Broadwey M.C.—The session concluded with a short sketch entitled "*The Morse Code Detective*" written by the secretary. The Leader has started a series of First Aid lectures in which members take a great interest. Amateur acting is a popular feature of this club, Charades in which all the members take part being frequently arranged. A good programme of Cycle Runs has been arranged for the summer. Club roll: 14. *Secretary*: W. O. Doylend, Cranford, Jesty's Avenue, Broadwey, Nr. Weymouth.

Halifax M.C.—The Exhibition held last session was a great success, the excellent Models shown being evidence that model-evenings are a very popular feature. Among those exhibited were the Walking Tractor, a Tower Searchlight, and Motor Lorry with electric lighting. A very interesting Lecture on "*A Spinning Frame*" given by the Leader, and a Cinematograph Display figured recently in the programme and were very much enjoyed. Members are very enthusiastic over the prospects of the summer session, and arrangements have been made for Rambles and Cycle Runs over the moors. A successful Cricket season is also anticipated. Club roll: 29. *Secretary*: C. Walton, 22, Milton Street, Halifax.

Bristol Grammar School M.C.—A Lantern Lecture on "*Bridges*" was found most interesting by the members. Slides were shown illustrating the story of bridges from the very earliest times down to the present day. A visit to the Avonmouth Docks was greatly enjoyed, the cold storage room, where the temperature was 16° below freezing point, attracting special interest. Model-building is a popular feature of the club and the members have made many excellent models that were on view at the recent Club Exhibition. A very large number of visitors attended the Exhibition, where a Hornby Layout attracted much attention. The play "*Nonsense Nana*" was given and the audience were very enthusiastic about it. Club roll: 40. *Secretary*: S. H. Evans, 44, Belluton Road, Knowle, Bristol.

Liverpool M.C.—An interesting programme included two lectures, one on "*Canals*" and the other one on "*Engineering.*" Both were greatly enjoyed by the members. It has been decided to organise Cycle Runs for the summer months, and the President has presented a number of table games for indoor recreation. The members recently paid a visit to the Meccano Works and were fascinated by the wonderful machinery used in making Meccano parts and in the construction of Hornby Trains. An inspection of the White Star Liner "*Baltic*" also proved very interesting and enjoyable. Club roll: 16. *Secretary*: Royston Varley, 18, Lilford Avenue, Orrell Park, Liverpool.

Newcastle-on-Tyne M.C.—A renewed effort is being made to revive this club, which has been suffering from the absence of the Leader owing to illness. Fortunately he has now made a complete recovery. A new club-room is being secured and intending members should communicate with Mr. Gilbey, who will be pleased to give full details. *Leader*: Mr. G. Gilbey, 205, Welbeck Road, Byker, Newcastle-on-Tyne.

Middlesbrough M.C.—An Election on Parliamentary lines was held to find a successor to a Section Leader who found it necessary to resign. Speeches from the candidates and "heckling" in approved style made a really interesting feature out of a piece of necessary business. The hundredth meeting of the club was made the occasion of a special meeting for a discussion on the club magazine. Criticism was invited—and received!—and prizes were awarded for the best answers to a series of questions designed to bring out valuable suggestions. A novel evening when the club was conducted by the members instead of the officials proved to be a very enjoyable burlesque on the latters' activities. A very attractive competition was arranged by the President, in which members were required to describe the working of a Petrol or Steam Engine. Rambling and Cycling Sections have been formed and it is hoped to hold many outings during the summer months. In a Mock Trial held some time ago, the secretary was charged with hoaxing the club. After some very amusing arguments and a few ejections the prisoner was dismissed with a caution. The Leader and secretary recently paid a visit to the Darlington M.C. Club roll: 55. *Secretary*: A. Bradley, 95, Deepdale Avenue, Marton Grove, Middlesbrough.

Annan M.C.—The club exhibition was held recently, the club-room being splendidly decorated. Many excellent models were on view, the Meccanograph, the Motor Chassis and a Roundabout driven by a miniature steam engine exciting great interest. A model of Major Segrave's car that could travel at 15 m.p.h. attracted special notice The Hornby Train layout also proved attractive. It was very realistic, the line running through sand-banks and over duck-ponds. A concert, held in connection with the Exhibition, was a huge success and a large number of visitors were present. Club roll: 28. *Secretary*: W. F. Duff, 10, Hecklegirth, Annan.

Great Baddow M.C.—Members have been concentrating on Model-building for some time and many splendid models have been constructed. The builders of the two best models in each section were awarded prizes of money, to buy new Meccano parts, by the Leader. The winning models in the senior section were Swivelling Cranes, and in the junior section Sewing Machines. A Cricket Team is being formed for the summer, and a regular programme of interesting matches has been arranged. Club roll: 35. *Secretary*: Miss D. K. French, High Street, Great Baddow.

Haslingden Secondary School M.C.—The fine models entered in the latest Model-building Contest were judged by Mr. J. Barton, B.Sc. The first prize was won by a fine model of a Pithead Gear, the second prize by a Motor and the third prize by a good model of a Crane. The Leader gave a Lecture on "*A Tour in North Wales*" at a recent meeting. This was illustrated by lantern slides loaned by the London Midland & Scottish Railway Company. The club exhibited a selection of models on the occasion of the Annual School Conversazione. The school was open to visitors and the exhibit attracted very favourable attention. Club roll: 18. *Secretary*: F. K. Illingworth, 7, Hud Hey Road, Haslingden, Rossendale.

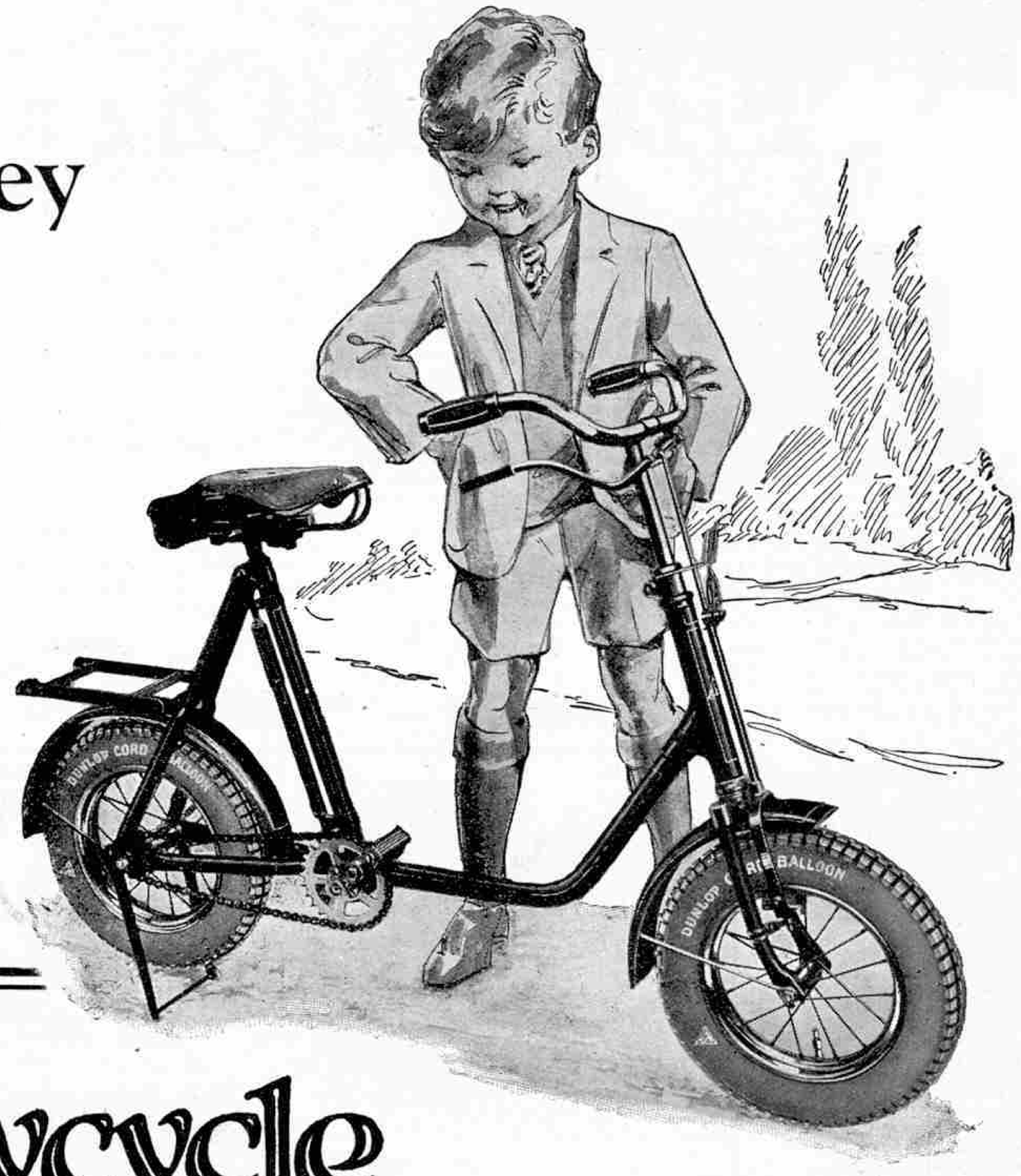
Holy Trinity (Blackburn) M.C.—The club has been divided into Senior and Junior Sections. Each section has its own club-room, and the Assistant Leader is in special charge of the Junior Section. An interesting Aeroplane Night was held recently. A keen fight is proceeding between the Bolts and the Nuts for the Shield held at present by the former, and the Nuts are at present leading by six points. The Annual Exhibition was a great success, the Meccano Workshop lent from Headquarters proving a great attraction, and the sum of £5 10s. 0d. was handed over to the Sale of Work funds. Visits have been exchanged with the Preston Embee M.C. Club roll: 51. *Secretary*: Frank Hulme, 23, Primrose Bank, Blackburn.

Harwich M.C.—Hard work by the members, and the assistance of many kind friends, made the 4th Annual Exhibition the most successful of any yet held. On the first evening the opening ceremony was performed by Councillor Mrs. Lucy Hill, J.P., and on the second evening by Mrs. Low. The club-room was tastefully decorated and many fine models were displayed in a very attractive manner. Stalls were devoted to Raffia Work, Stencilling, Bead-making and modelling in Plasticine. Flowers of all kinds were being modelled at the Plasticine Stall and sold to visitors, while at the Stencilling Stall designs were being marked on handkerchiefs, also for a very small sum. The Leader, Mr. Hogg, exhibited several of his excellent oil and water colour paintings which were greatly admired by everyone. A Hornby Train Layout kindly loaned by Messrs. F. G. Petch, a gaily-decorated Fretwork Stall and an interesting tableau consisting of a sea picture painted by Mr. Hogg, surrounded by model Battleships, Destroyers and Lighthouses, were other noteworthy features. A good sum was realised by the Toy Soldier Section, one member being kept very busy moulding battleships and soldiers which the visitors could purchase. Prizes won during the session were presented at the Exhibition. *Secretary*: Mr. Alfred A. E. Ward, Osborne House, Pepy's Street, Harwich.

Malvern Wesleyan (S.A.) M.C.

Our photograph shows a group of members of the Malvern (Johannesburg) club at the end of a 15-mile cycle race, with Mr. S. Hobson, the club trainer, on the right. Sports are very popular among the members and the annual sports meeting held each year is a notable event. In every way the club is conducted on splendid lines under the excellent Leadership of Mr. E. Sykes, who has taken a great interest in all its activities since affiliation was granted in 1921

"Won't they all be envious!"



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REGD TRADE MARK

with

Dunlop Balloon Tyres

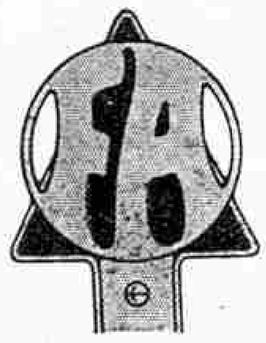
Just think how proud you would feel if you owned a No. 8 Fairycycle exactly like the one illustrated.

Not only is it a completely equipped machine but the big 2¼" Section Dunlop Balloon Tyres—real car tyres in miniature—also make it so very comfortable to ride.

Other features of this fine model are nickel-plated rims, upturned handlebars, rim brake, stand and carrier.

OTHER FAIRYCYCLE MODELS

No. 1, with tangent spoke wheels, ⅝" ribbed tyres, stand and carrier	39/6
No. 2, with stand and carrier, ¾" ribbed tyres, rim brake, upturned handlebars, tangent spoke wheels	49/6
No. 3, De Luxe Model, as Model 2 but with ball bearing wheels, ⅞" ribbed tyres	59/6
No. 4, Super Fairycycle as Model 3 but with ball bearings throughout and spring saddle	65/-
No. 6, Senior Model with 16" wheels, ⅞" ribbed tyres, ball bearings throughout	70/-
No. 7, as Model 6, but with pneumatic tyres	75/-



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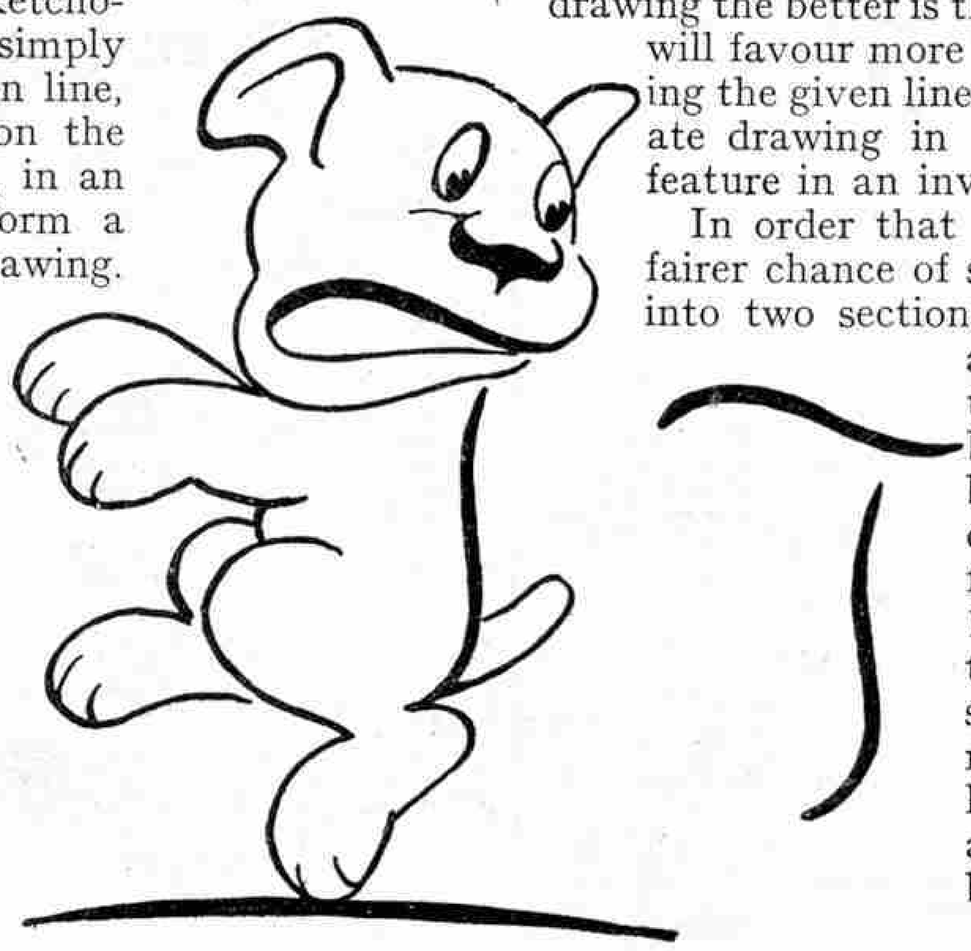
Competition Page

"Sketchograms"

Here is a competition designed specially to interest our sketching readers and also to amuse those whose only claim to artistic merit is ability to draw a curved line. First of all the art of sketchograms must be explained. It is simply the ability to incorporate a given line, or lines, such as those shown on the right of the dog illustrated here, in an original sketch so that they form a principal feature of the finished drawing.



To make the idea clear our artist has drawn not only the sketchogram with which readers are asked to experiment, but also the sketch he had in mind when he drew it. Thus it will be seen that the upper part of the dog's mouth and the outline of his back, are formed by the sketchogram.

Readers are asked to make an original sketch in which the two lines of the sketchogram shown, form part. Obviously the drawing of the dog must not be copied but quite a number of other possibilities will present themselves after the lines have been studied for a few moments. It must clearly be understood that the position of the individual two lines in their relation to one another must not be altered, but the sketchogram as a whole can be turned upside down or tilted to any desired angle. The simpler the drawing the better is the chance of success and the judges will favour more a straightforward sketch embodying the given lines as a main feature than an elaborate drawing in which they are merely a minor feature in an involved design.

In order that our younger readers may have a fairer chance of success the entries will be divided into two sections, A, for those from competitors aged 16 and over, B, for those under 16. The first and second best entries in each section will be awarded prizes of Meccano products (or artists' materials, if preferred) to the value of £1/1/– and 10/6 respectively. In addition there will be a number of consolation prizes. Each competitor may submit as many entries as he wishes, but his name, age and address must appear on the back of each.

Entries must be addressed to "Sketchograms, Meccano Magazine, Binns Road, Liverpool," and must arrive not later than 31st July. Overseas closing date, 31st October. Entries cannot be returned unless a stamped addressed wrapper is enclosed.

35th Photographic Contest

It has always been our aim in "*M.M.*" competitions to provide subjects that will interest the greatest possible number of readers. That has not always proved a simple task when photographic contests have had to be arranged, but this month, we feel certain, an opportunity to take part is given to every photographic reader.

The special subject is "An Engineering Photograph." Within the scope of this title come locomotives, cranes, ships, aeroplanes, docks, building operations—in fact everything that moves by machinery or was created with the aid of machinery. The subject requires no further explanation and we look forward to a record entry.

Prizes of Meccano or Photographic goods, to be selected by the winners, to the value of 10/6 and 5/– respectively, are offered to the senders of the best and second best photographs in each of the two sections into which the competition is divided, A, for those aged 16 and over, B, for those under 16. Competitors may submit as many prints as they wish, but each must bear the name, age and address of the competitor on the back. The negatives of prints submitted must have been exposed by the entrant but the finishing may have been done by a professional. All other matters being equal preference will be given to prints that are entirely the work of the competitor. Those who performed not only the exposure of the negative, but also the development of the negative and the making of the print, should make a note to this effect on the back of their prints.

Entries must be addressed to "35th Photographic Competition, Meccano Magazine, Binns Road, Liverpool," and must reach this office not later than 31st July. Overseas closing date, 31st October.

Home Result

25th Drawing Competition.—The entries for this competition, the subject of which was Captain Campbell's "Bluebird" Napier racing car that established a world's record speed on the sands at Daytona Beach, Florida, as detailed in the "*M.M.*" for May last, clearly showed that Captain Campbell's feat had struck a responsive chord in the imaginations of our readers. Never previously have we encountered so many really excellent drawings in one competition. As may be imagined the judging called for even more care than is customarily given to this task, and the final awards were made only after minute details had been weighed in the balance. In such circumstances we always feel a tinge of regret that it is impossible to give every competitor a prize!

The full list of awards is as follows: First Prizes: Section A, A. R. SEWALL (St. Ives, Hunts.); Section B, N. SHACKLOCK (Longsight, Manchester); Second Prizes: Section A, H. LANE (Stokesley, Yorks.); Section B, R. K. BOUSTRED (Bowes Park, N.22). Consolation Prizes: G. WHITHAM (Edinburgh); E. M. PRIVETT (Bishop's Waltham, Hants.); R. J. F. BOWDEN (Plymouth); R. J. BANKS (Gillingham, Kent); W. LOCHRIDGE (Airdrie); O. A. KIMMINGS (East Acton, W.3); S. HOWSON (Workington).

Overseas Results

Bottled Parts.—The staff artist is a chastened person. When he was called upon to prepare the now famous bottle of Meccano parts, he rolled up his sleeves, sharpened his pencil and proceeded to concoct what he declared would put a "stopper" on the success of sharp-eyed Meccano boys. We must confess we were of opinion he had succeeded when first we saw the finished drawing. Let us draw a veil over our artist's face when we confronted him with the entries. It is enough to comment "Oh! What a fall was there!"

Actually over 200 boys succeeded in giving a completely accurate solution. We always have held a profound admiration for the Meccano boy's keenness and in admitting that we doubted whether it was possible for more than a mere handful to approach even an 80 per cent. accurate solution, we are delighted to have found ourselves sadly in error.

In appending the correct solution, we must explain that although 36 parts are listed, all boys who omitted the axle rod have been credited with one mark. The reason for this is that the cone pulley and axle rod are separate parts, but in certain of our illustrated lists and in the jar illustrated in the contest, the cone pulley and axle rod are illustrated together. Quite a number of boys thereby were misled and it would be unfair to penalise them for a fault of our creation.

The actual parts were:—

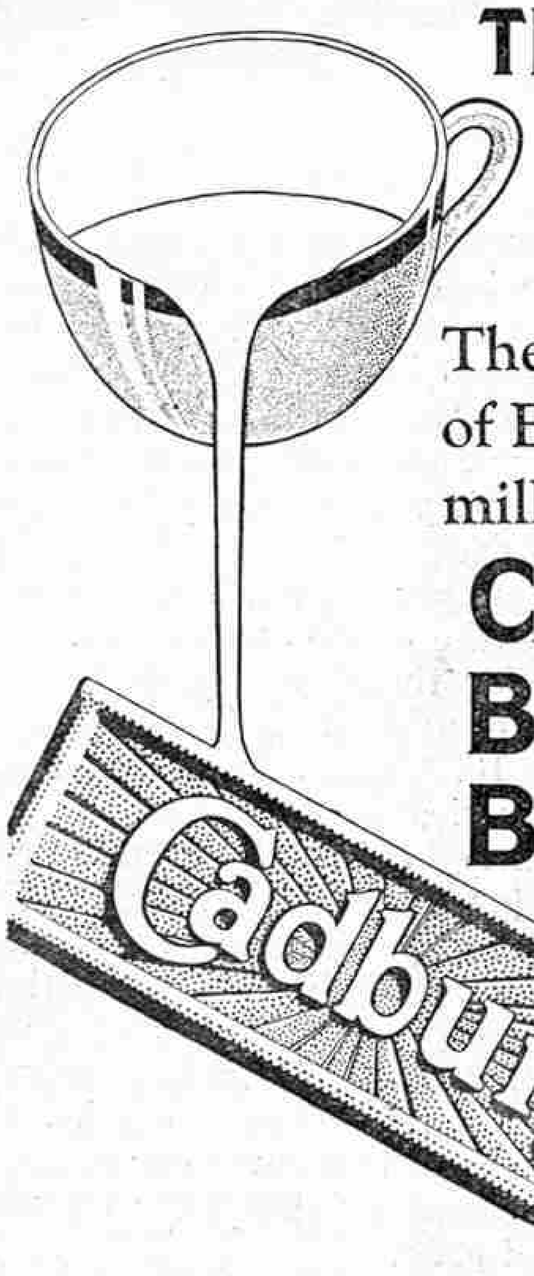
Nos. 3, 12, 18b, 19, 20, 20a, 23, 24, 29, 32, 34, 35, 37, 38, 41, 57, 59, 62, 63, 90a, 108, 110, 115, 116, 123, 126, 133, 136, 137, 138a, 147, 152, 156, 156a, 160, 162,

The prize-winners' names are as follows:—

1. H. W. TURNER (Hastings, N.Z.); 2. S. F. DESAI, (Navsari, India); 3. A. ABDULRAHIM (Karachi, India). Consolation Prizes: W. J. SMITH (Auckland, N.Z.); G. WALLIS (Victoria); B. K. CHOKSI (Karachi, India); WM. H. DELAY (Ceylon); H. FAGG (Otago, N.Z.); J. SHARPLEY (Hastings, N.Z.); H. C. VAN DOORN (Utrecht, Holland).

24th Drawing Contest:—First Prizes: Section A, D. SHORES (Winnipeg); Section B, J. ROWLAND (Cambridge, N.Z.); Second Prizes: Section A, E. BONNICI (Valletta, Malta); Section B, L. M. NOGUERA (Buenos Aires). Consolation Prizes: W. BLOMKAMP (Cape Town); P. J. Cox (Adelaide); S. P. SENJI (Madras).

ATHLETES
TRAIN ON IT



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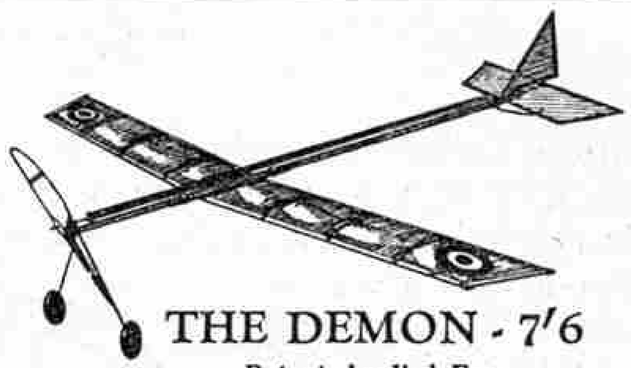

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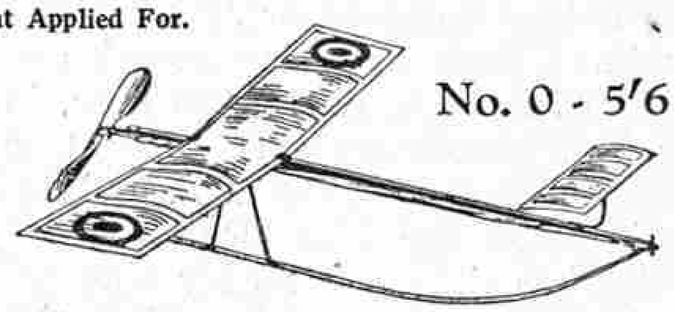

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The Making of a Cricket Bat

From Willow to Wicket

IF one were asked to name the most typically English of all games the reply would most certainly be cricket. Many people are under the impression that cricket is a comparatively modern game, but as a matter of fact its history goes back many centuries. Its exact origin is shrouded in mystery, but it appears to have been developed from a crude game of which we possess drawings dating from the twelfth century.

It is interesting to note that in the early days of the game there were no stumps, their place being taken by a circular hole in the ground. Exactly how the game was then played is not known, but apparently the batsman could be "out" by the ball being caught, or by the ball being returned to the hole while he was in the act of running. At a later period one stump about 18 in. in height was introduced, and the object then became to strike and displace this stump by the ball instead of throwing the ball into a hole.

Sutcliffe (Yorkshire) instructing a schoolboy how to hold the bat

It is not known when a second stump was added, but we do know that the two were placed 2 ft. apart with a connecting cross-bar on the top. In 1775 a third stump was added between these two to obviate the possibility of the ball passing between them without displacing the cross-bar. Since that time various alterations have been made in the dimensions of the stumps but otherwise there has been no great change. As far as can be ascertained, the game throughout its history has been played with the wickets one chain, that is 22 yds., apart.

In the earlier records of the game it is made quite clear that cricket was not regarded as a fit pastime for the nobility and gentry and that it was patronised mainly by the lower orders. In 1365 Edward III made an attempt to prohibit the game on the ground that it was interfering with the practice of archery. This attempt was unsuccessful, but in 1477 cricket again came into royal disfavour and for the same reason. This time an Act was passed that rendered anyone who allowed the game to be played on his premises liable to a fine of £20, while those who played the game were to be fined £10 and imprisoned for two years and all the implements were to be burnt!

This persecution naturally slowed down the progress of the game, but its vitality was such that it never became obsolete. In the latter part of the seventeenth century there came a distinct revival and there are records of the game being played at public schools, in particular at Winchester and Eton. From that time the game rapidly attained popularity and ultimately in 1748 official approval was given to it when the courts decided "that it was a very manly game, not bad in itself, but only in the ill use made of it by betting more than ten pounds on it."

The early cricket bats were very cumbersome and heavy implements in comparison with the beautiful productions of the present day. The making of a modern cricket bat is a very highly specialised industry demanding skill and experience. The best timber for bat-making is a variety of willow named *Salix Alba Coerulea*. This tree, which is found chiefly in Essex, is close barked and straight grained and has the further advantage of rapid growth. An ideal willow suitable in all respects for the manufacture of cricket bats has a sturdy trunk about 10 ft. in height, free from side shoots, and with a very slight taper and ending in a heavy spreading top. This trunk is cross cut into lengths of 2 ft. 6 in. and each length is riven or split into pieces large enough for cricket bat blades. The object of riving the willow is to keep the blade straight in the grain. These pieces of willow are then dried by natural seasoning. They must not on any account be force dried, and therefore from eighteen months to two years must elapse before they are brought from the seasoning sheds to pass through the processes of manufacture.

Photographs courtesy [*Gamages Ltd.*

Sutcliffe in action!

The methods employed in different factories vary to some degree, but in general they follow similar lines. The following brief description of the making of the famous "Wilfred Rhodes" bat at the Walter Lambert Works, Nelson, Lancashire, outlines the general methods adopted for the making of bats of the highest quality. The first process is to face the blade and this is followed by compressing. The blade is fixed into a pressing machine and rolled on the face a little, the pressure being gradually increased. This is a very important process, for a bat blade that has been pressed too hard will not drive as sweetly as it should and, on the other hand, a bat that has been under-pressed will not stand up to the ball. The next stage is to make the cuts in the blade for the splice. This is carried out by an ordinary circular saw, two cuts being put in at different angles to form the V.

The handle is made (*Continued on page* 549)

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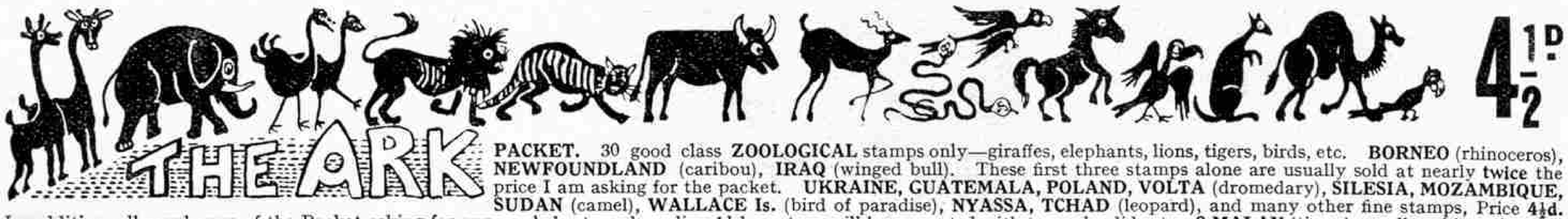
PORTER, 20, Sydner Road, Stoke Newington, N.16

New Meccano Models—(*continued from page* 601)

$3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip secured between the vertical Flanged Plates.

The centrifugal governor is represented by a large Fork Piece with two Collars attached to indicate the weights. The Fork Piece is secured to the end of a vertical Rod that is journalled in the framework shown and in a hole in the base Plate. The governor is rotated by means of an endless cord passing round the belt pulley formed from two $\frac{3}{4}''$ Flanged Wheels fixed to the governor shaft, and also round the 1" Pulley on the Crankshaft. The method of mounting the Boiler and chimney, etc., will be clear from the illustration.

The following parts are used in the construction of the Horizontal Engine: 5 of No. 5; 2 of No. 8; 2 of No. 12; 3 of No. 15a; 2 of No. 19b; 4 of No. 20b; 1 of No. 21; 1 of No. 22; 2 of No. 35; 30 of No. 37; 3 of No. 48a; 2 of No. 48b; 2 of No. 52; 3 of No. 53; 5 of No. 59; 1 of No. 116; 2 of No. 126; 1 of No. 134; 1 of No. 162; 1 of No. 163; 1 of No. 165; 1 of No. 166.



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In addition, all purchasers of the Packet asking for approval sheets and sending 1½d. postage will be presented with two splendid sets—**8 MALAY** (tigers) usually sold at 10d. and **12 HUNGARY** (Turul—the mystic bird of the Magyars) catalogued 1/-. Send addresses of stamp collecting friends and receive an extra set free.
H. C. WATKINS (M. DEPT.), GRANVILLE ROAD, BARNET

Stamp Gossip

The Set of the Year

Newfoundland has ever been a popular stamp issuing country and its reputation is enhanced by the new permanent designs that recently made their appearance. The new issue has 13 denominations, ranging from one to 30 cents in value. The stamps themselves are somewhat larger than has been the case with earlier Newfoundland issues and in consequence it has been possible to produce even more beautiful designs. Each of the subjects chosen for illustration depicts one of the many interesting aspects of the Dominion's history.

Thus on the 1 cent value there is a map showing Newfoundland and the territory on the Labrador coast that recently has been made over to the Dominion. The 2 and 5 cent stamps depict two forms of transport, the former showing the s.s. "*Caribou*" that runs from St. Johns to Sydney, Nova Scotia, in nine hours, and the latter an express train crossing Newfoundland. This is declared by *Gibbons' Stamp Monthly* to be quite the best railway design that has yet been issued. An interesting feature of the 6 c. value is the illustration of the Newfoundland Hotel at St. Johns. It would seem to be an extremely novel advertisement for the proprietors of the hotel and strikes quite a new note in stamp publicity. Other buildings are shown on the 12 c. stamp, the G.P.O. at St. Johns, and on the 20 c. stamp, Parliament House, St. Johns.

The most interesting stamps of the series are the 8, 9 and 15 cent values, each of which records a unique incident in the annihilation of space. They are respectively, the landing of the first trans-Atlantic cable, the reception of the first trans-Atlantic wireless signal and the start of the first successful trans-Atlantic flight. This stamp is illustrated on this page. The flight, it will be recalled, was performed in June, 1919, when Sir John Alcock and Sir Arthur Whitten Brown, two British aviators, flying a "Vickers Vimy" machine, crossed from Newfoundland to the West of Ireland, 1,890 miles, in 16 hrs. 12 mins. The 10 c. stamp shows the War Memorial at St. Johns, while the 40 cent value is used to show the beautiful scenery at the Grand Falls, Labrador. The remaining stamps show portraits of their Majesties the King and Queen on the 3 cent, and the Prince of Wales on the 4 cent values. This issue undoubtedly forms one of the most noteworthy sets of the year.

Literary Stamps

It is probable that two examples of the honouring of literary and artistic genius further to those mentioned in the paragraph in our April issue, will make their appearance shortly. A special Austrian postcard stamp is to be issued in connection with the Schubert celebrations later this year, while Russia proposes to issue new stamps in honour of Tolstoi and Gorky.

Even before our April note appeared a new literary stamp had made its appearance, when Norway celebrated the centenary of the birth of Henrik Ibsen, the great Scandinavian playwright and poet. Ibsen was born in Norway on the 20th March, 1828, and, like many another author, his early days were spent in abject poverty. His experiences embittered him and many of his works at first created a furore until it became recognised that he stood not to destroy society, but rather to cure its evils by frank exposure. Thus one may well liken him to Dickens, who probably will rank for ever as England's greatest social novelist.

* * * *

A New Cyprus Issue

To commemorate the 50th anniversary of the establishment of British rule in Cyprus, a new series of stamps was recently issued. It consists of ten denominations, ¾, 1, 1½, 2½, 4, 6, 9, 18 and 45 piastres and £1.

Our illustration shows the 1½ piastre value, the design of which takes the form of a map of the island showing the principal cities and Mount Olympus. In the bottom left-hand corner the goddess Aphrodite is shown rising from the sea at Paphos. The other designs are as follows:—¾ piastre, a reproduction of a silver coin of Amathus, one of the nine Greek kingdoms of the island in the 5th century, B.C. 1 p., a portrait of the philosopher Zeno, who was born in Larnaca, which city is shown on the map on the 1½ p. value. 2½ p., a part of an 18th century fresco in the Greek Orthodox Cathedral of St. John, Nicosia, depicting the finding of the body of St. Barnabas at Salamis in the 5th century, A.D. 4 p., the arms of the Colony, consisting of two lions of gold of the style that were shown on the banners carried by Richard Cœur de Lion at the taking of Cyprus while on his way to the third Crusade. 9 p., a sketch of the Tekke of Umm Haram, a relative of the Prophet Mohammed, who was with her husband's forces when Ubaida invaded Cyprus in the 7th century, A.D. Umm Haram fell from her mule and died on the banks of the Larnaca salt lake. She was buried under a prehistoric monolithic structure and the spot now is one of the most revered of Moslem shrines. 18 p., a reproduction of the bronze equestrian statue of Richard Cœur de Lion, which is erected outside the House of Lords in London. 45 p., the facade of the Cathedral of Famagusta, built in 1300, A.D. This was the cathedral where the Kings of Cyprus were crowned Kings of Jerusalem. £1, a profile portrait of H.M. King George V.

Cyprus lies in the eastern basin of the Cilican Sea, and is the third largest island in the Mediterranean. It has an area of

3,584 sq. miles and its population is approximately 350,000.

Cyprus has played a great part in the history of the Near East and its earliest link with Britain was its conquest in 1191 A.D. by Richard Cœur de Lion, then on his way to his third Crusade in Palestine. The island's patron saint is St. Barnabas, who landed with St. Paul at Salamis in the year 45 A.D., and there preached the Gospel. St. Barnabas was a native of Cyprus but even this did not save him from the persecution of disbelievers and eventually he was put to death in his country.

* * * *

Franciscan Commemoratives

As a matter of general interest we reproduce the 2.50 lire stamp of the recent San Marino Franciscan Commemorative issue, that takes for its design the death of St. Francis of Assisi. The same scene depicted on the 1928 Italian issue, also commemorating the 7th Franciscan Centenary, is shown to the left of the heading of this page. The scene at the death of St. Francis is a matter of vague historical reference only and this, of course, accounts for the different visualisation by the artists responsible for the respective stamps.

POOR DOG!

It was a bitter winter's night. Brown had been to supper with the Smiths, who lived in a distant suburb a mile and a half from the nearest railway station.

Smith, opening the door for Brown's departure: "What a night! Not fit to turn a dog out! Well, good-night, old chap. Hope you find your way to the station all right."

* * * *

Tommy (the novelist's son): "Funny thing, isn't it? I get licked for telling stories, and here's pa writing them all day long, and getting paid for them."

* * * *

SOMETHING WORTH KNOWING

A guide had been showing a party of visitors round a great picture gallery, and when they had been through all the rooms he said:

"And now, ladies and gentlemen, if anyone would like to ask a question I shall be happy to try and answer."

"Well," said a lady, "can you tell me what brand of polish they use to keep these floors so beautifully shiny?"

* * * *

At a party a lady had been playing the piano for some time. She stopped at last and turned to a man who suffered from absent-mindedness.

"I have been told that you love good music," she said.

"Oh, that doesn't matter!" he replied. "Please go on."

* * * *

First Witness: "Tell all you know. It will not take long."

Second Witness: "I'll tell them all we both know, it won't take any longer!"

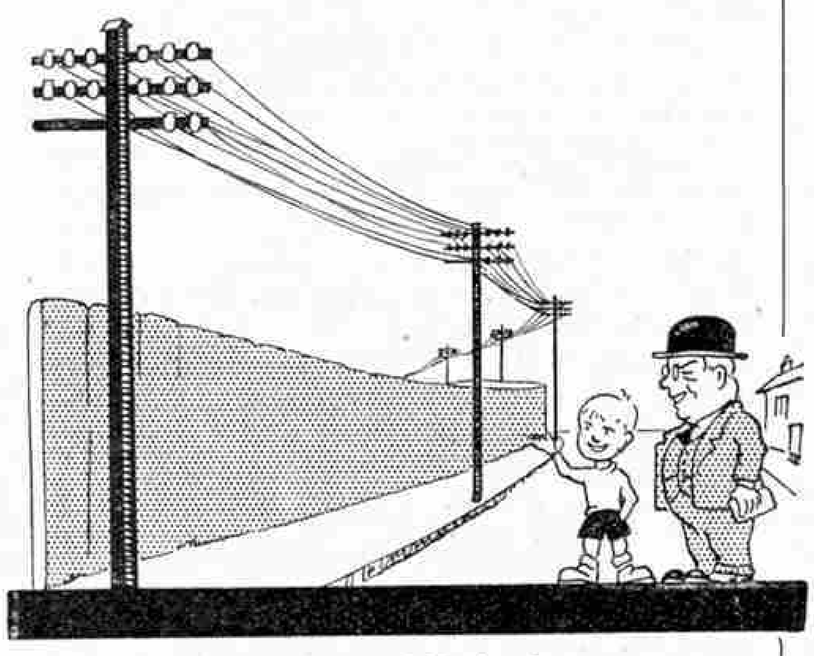
* * * *

Friend: "All the mechanical toys you make seem to be very successful."

Toymaker: "Yes, I've only had one failure, and that was too realistic. It was a toy tramp and it wouldn't work!"

* * * *

UP YOU GO



Stout Gent: "Sonny, which is the nearest way to see the cricket match?"

Sonny: "Right up this telegraph pole."

* * * *

A MAN OF RESOURCE

"I'll have a couple of poached eggs, please," said a man on a walking tour as he entered an Irish inn.

The innkeeper grinned apologetically. "Im sorry we have no eggs," he said, "but I could let you have some poached salmon on the quiet."

* * * *

"What is your husband's daily pursuit?" asked the census taker. "The 8.25 train," replied the wife promptly.

OUTSIDE HIS LIMIT

A simple farmer had come into town to buy a horse.

"I have the very animal for you," said the dealer. "Five years old, perfectly sound, and goes ten miles without stopping."

"Then it's no good to me," said the farmer. I live eight miles out in the country, and I don't want to walk two miles back after that horse has stopped."

* * * *

"Every night I write in a notebook all the good ideas I have had during the day."

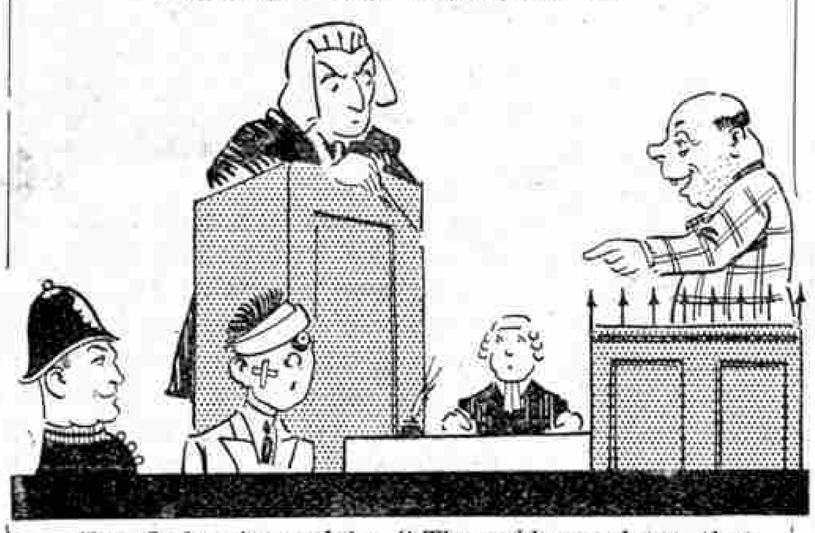
"Really? How long have you been doing this?"

"About three years."

"My goodness! The first page must be nearly full."

* * * *

WEIGHT OF EVIDENCE



The Judge (severely): "The evidence shows that you threw stones at this man."

Prisoner (with unconcealed satisfaction): "And the look of him shows more than that. It shows I hit him!"

* * * *

NO LIFE IN IT

The children thoroughly enjoyed the great circus during their holiday. Next week, by way of a further treat, they were taken to the Natural History Museum. They came home rather depressed.

"Where have you been?" they were asked.

"We have been to a dead circus," was the doleful reply.

* * * *

It was dusk as she stopped at the roadside garage.

"I want a quart of red oil," she said.

The man gasped and hesitated. "A q-quart of r-r-r-red oil?" he said.

"Certainly," she replied, "My tail light has gone out!"

* * * *

VERY SORRY

Office-boy: "A gent called when you was out, sir, and said he had come to give you a good thrashing."

Manager: "What did you tell him?"

Office-boy: "I said I was sorry you were not in!"

* * * *

The Judge: "You were found under a bed with a bag of tools. Any excuse?"

The Prisoner: "Force of habit, your Lordship, I've been a motorist."

* * * *

Tim (nervously): "Will that dog eat out of your hand?"

Ted (proudly): "Yes, and out of your leg, too, if he gets the chance."

* * * *

Mrs. Jinks: "How did that naughty little boy of yours get hurt?"

Mrs. Binks: "That good little boy of yours hit him on the head with a brick!"

* * * *

WILLING TO WORK

The Householder: "So you're out of work, are you? Then you're just in time. I have a pile of wood I want chopped, and I was just going to send for a man to do it."

The Tramp: "Right you are, sir. Tell me where he lives and I'll fetch him."

SO BRACING

The fisherman was tired of answering visitors' questions. "Is this place really as bracing as they say?" asked one of them.

"It's amazing," he replied. "You ask the neighbours; they'll tell you that when I came here I was so weak I couldn't walk."

"Really?" said the visitor politely.

"Yes, really," said the old salt. "You see, I was born here."

* * * *

Two men were having a fierce argument, and at last one of them walked away with this parting shot:

"The sooner I never see your face again the better it will be for both of us when next we meet!"

* * * *

"Why did you not go to the help of the complainant when you saw he was having such a desperate fight for it?" asked the magistrate of the witness.

"Because I did not know till the fight was over which was going to be the complainant," was the reply.

* * * *

NOTHING BUT EATING

A countryman went to London to see the sights. He booked a room at a hotel, and before going to bed asked the head waiter about the hours for meals.

"We have breakfast from seven to eleven," was the reply, "lunch from twelve to three, and dinner from six to eight."

"Well," said the astounded countryman, "when do you think I am going to find time to see London?"

* * * *

Two men were dining together in a restaurant, and they ordered half a chicken. When the meal was served one of the men carved off the leg for himself and offered the remainder to his friend.

When the friend protested the first man said: "What would you have done if you had been carving?"

"I should have given you the best part of the bird, of course."

"Well, I've got it, haven't I?"

* * * *

"Doctor, when should I take these pills?"

"One hour before you feel the pain coming on!"

* * * *

A "DOUBLE-ENDER!"

First Tramp: "'Ere, why don't you go in? The dog's waggin' his tail."

Second Tramp: "Yes, an' he's growling, an' I don't know which end to believe."

* * * *

PLENTY OF ROOM AT THE TOP

A boy who had just left school went to a big city and entered the offices of the first firm he saw.

"I am willing to do any sort of work," he said to the manager. "What chance is there here for a young man who is prepared to begin at the bottom and work his way up?"

"No chance at all, I'm afraid," replied the manager. "We are contractors for digging wells."

ONE BETTER

An American was in Naples during an eruption of Vesuvius, and as he was watching the wonderful spectacle an Italian said with pride:

"You have nothing like that in America, have you?"

"No," replied the American; "we haven't. But we've got Niagara Falls, and they would put the whole thing out in five minutes."

* * * *

WHO DID IT?

A schoolmaster was telling a party of friends a funny incident during a history lesson. "The other day," he said, "I asked my class who signed Magna Carta, and a nervous little boy stood up and said, 'Please, sir, it wasn't me.'"

One of the party laughed loudly at this story, and then exclaimed: "And I'll bet it was that little rascal who did it after all!"

* * * *

"There you are sir, have a good gallop. Pony for you and another for the lady."

"Thanks (loftily); but I'm not accustomed to that class of animal."

"Hi, Bill, look sharp! Gent. will have a donkey."

* * * *

There is a lady secretary in the Civil Service who addressed a letter to Newport, Mon., as Newport, Monday.

In due course it came back through the Dead Letter Office. Asked whether she had ever heard of such a place as Newport Monday, she tearfully replied: "No, but I thought it was alright because I've often heard of Sheffield Wednesday." (*Humour in the Civil Service*).

* * *

The shaking of the table caused the jelly to quiver.

"Will you have some, Jimmy?" asked the hostess.

"N'no, thank you, said Jimmy, nervously, "I don't think it's dead yet."

* * *

Mother: "You were very naughty to disobey me, and I have punished you to impress it on your mind."

Son: "Mummy, aren't you mistaken in regard to the position of my mind?"

* * *

NUTTY!

It was during the botany lesson, and the master had been explaining the different kinds of nuts, cobnuts, coconuts, Brazil nuts, chestnuts, etc. Suddenly up shot a hand, and Jones minor, the wag of the class, asked in a squeaky voice: "Please, sir, do all nuts grow on trees?"

"They do, my boy," said the master.

"Please, sir, what about dough-nuts?" asked Jones minor.

A titter ran round the class; but the master was equal to it.

"Oh, dough-nuts?" he repeated slowly. "Yes, they grow on trees, too. Pantrees. And you can stay in after class and write out that interesting fact a hundred times, Jones!"

* * * *

A small boy and his sister were playing on the doorstep when a mounted policeman passed.

"Which would you rather be, a mounted policeman or a foot policeman?" asked the boy.

"I would prefer to be a mounted policeman."

"Why?"

"Because if robbers came along I could get away more quickly."

SO THAT IS WHY

Jones: "Why do you call your house a bungalow?"

Bones: "Well, you see, the job was a bungle and still owe for it."

* * * *

Jimmy: "This dictionary isn't any good."

Johnny: "Why?"

Jimmy: "Well, it hasn't any index to the words."

* * * *

A successful business man was boring a party of his friends with stories of his early struggles. "When I was a young man," he said, "I often used to keep the wolf from my door by my singing."

"I can quite believe that," remarked one of his hearers.

* * * *

A DUET

"I am told that you have twin baby brothers now," a lady said to a little boy. "Do they cry much?"

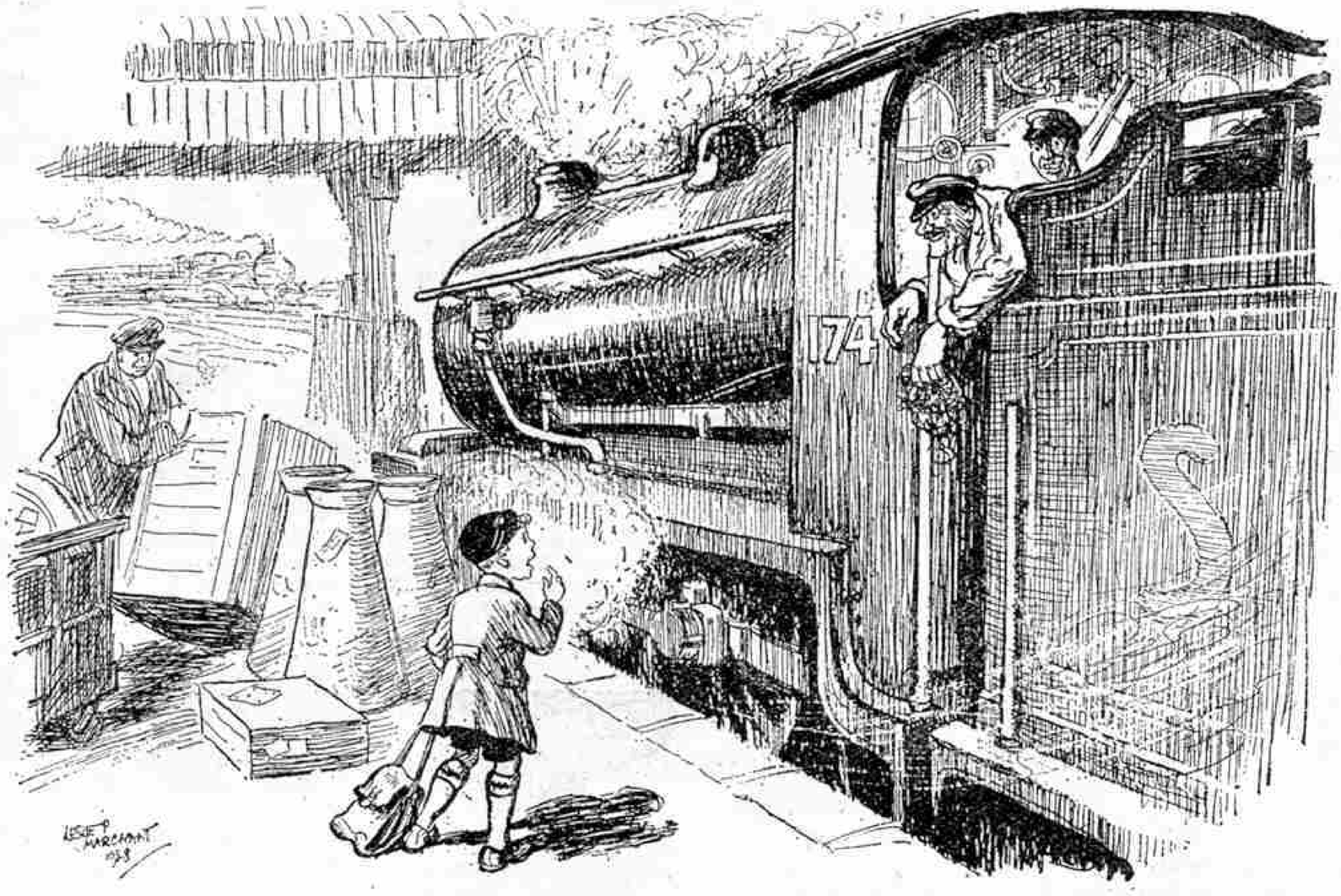
"They do!" said the boy in disgust. "Why, each one cries so loud that you can't hear the other."

* * * *

Teacher: "Do you know, Julius Cæsar could recite eight thousand lines of verse?"

Tommy: "No wonder they killed him!"

* * *



Schoolboy (to engine-driver): "I say, can you please just black my face for me, 'cos there's a couple of my Aunts looking all over the place to kiss me good-bye?"—*Courtesy of "The Humorist"*

Johnnie: "Do you know why a Ford Car is like a schoolroom?"

Jackie: "That's easy! Because it has a crank in front and a lot of little nuts behind!"

* * *

Teacher (after a long discourse on the habits of bees): "Now, Willie Smith, tell me how bees dispose of their honey?"

Willie: "Please Miss, they cell it!"

* * *

Magistrate: "Did you caution the prisoner in the usual way when you arrested him?"

Constable: "Sure, yr Honour, t'ree times acrost the head!"

* * *

A stout man had decided to take up golf, hoping thus to reduce his girth.

"Well, how are you getting on with it?" asked a friend.

"Not very well," he replied. "You see, when I place the ball where I can see it, I can't hit it; and if I put it where I can hit it, I can't see it!"

* * *

WHEN DUTY CALLS

The managing director of a big firm, who took a great personal interest in his employees, was passing through the factory one day when he saw a boy he did not recognise.

"Well, my lad," he said, "when did you start work here?"

"Only this morning, sir," replied the boy.

"I suppose you have seen the foreman, and he has told you what to do?"

"Yes, sir."

"And what did he tell you to do?"

The boy hesitated, and then said: "Well—er—he told me to wake him up when I saw you coming."

* * * *

WE ARE NOT ALL ALIKE

A man went to a dentist to have a tooth stopped, and for about five minutes the dentist's electric drill was grinding on the nerve of the decayed tooth. At last the patient could stand it no longer. "I gather from the sign over your door that you are a Painless Dentist," he said. "I should just like to remind you that although you may be painless I am not."

* * * *

Seedy Provincial Actor: "Young man, I hear you're going to act Hamlet. What induced you to do that?"

Prosperous London Actor: "Oh, I don't know. They egged me on to it."

Seedy Provincial Actor: "H'm. They egged me off!"

* * * *

FORCE OF HABIT

A kind-hearted mistress was writing a letter at the dictation of her maid, who was rather a poor hand at that sort of thing. At the end she asked: "Is there anything more you wish me to say?"

"No, Mum, thank you, Mum," was the reply; "only—Please excuse bad writing and spelling!"

TOURING THE WILD WEST

Author: "What is the audience shouting for?"

Stage Manager: "They're calling for the author."

Author: "Then hadn't I better go before the curtain?"

Stage Manager: "Better not! They've got out their revolvers!"

* * * *

Peter was playing at Johnny's house. When it was time to go home it started to rain. Mrs. White, however, gave Peter Johnny's raincoat and goloshes.

"Don't take so much trouble, Mrs. White," said Peter politely.

"I'm sure your mother would do as much for Johnny," she replied.

"My mother would do more," said Peter. "She'd ask Johnny to stay to supper!"

* * * *

WAS IT STRATEGY?

"Strategy," declared Murphy, up for examination, "is when you don't let the enemy discover that you are out of ammunition, but keep on firing."

* * * *

Some boys were forming a club, and one of their number had been asked to draft some rules. At the next meeting he read out as Rule Number 3:

"The Committee shall meet on the first Tuesday in every month, provided the same does not fall on a Sunday."

* * * *

WHAT'S IN A NAME?

A foreigner with a long and unpronounceable name came into a hotel, booked a room, and wrote his name in the visitors' book.

"Excuse me, sir," said the clerk, "but what is your name?"

"My name?" exclaimed the visitor angrily. "Can't you see I have written it in your book?"

"Yes, sir," said the clerk; "I can see it. That is what aroused my curiosity."

NOT ON THE MAP

A little boy put down the book he was reading.

"Dad," he asked, "where is Atoms?"

"You mean *what are* atoms," said Father; "there is no place called Atoms."

"No; I mean a place."

"Probably you are thinking of Athens."

"No; I mean Atoms—the place where things get blown to."

* * * *

First Passenger (on the Underground): "They tell me detectives have been put on here to catch people travelling without tickets."

Second Passenger (contemptuously): "Have they? Well, all I can say is that I can travel as often as I like from Cannon Street to Victoria without paying a penny!"

Detective (who has been pretending to be asleep in the corner seat, earnestly): "I say, mate, I'll give you five shillings to tell me how I can do that!"

Second Passenger (blandly): "By walking!"

* * * *

"That looks a well-bred dog."

"I should think he is well-bred. Why, he won't touch his dinner till I've put his collar on!"

* * * *

"I say, Mother Mathurin, my son has won a prize!"

"I can quite understand your feelings; we felt just the same when our pig won a medal at the agricultural show."

* * *

TOO LATE

Customer (back at the cash desk): "Look here! You didn't give me the right change just now."

Cashier (sharply): "Too late, sir! You should have counted it when I gave it you."

Customer (cheerfully): "Oh, all right! Only you gave me ten shillings too much. Good morning."

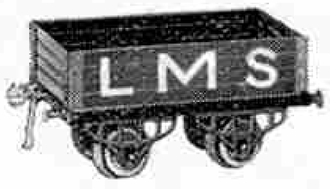
BRITISH AND GUARANTEED

ROLLING STOCK

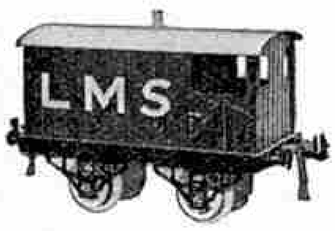
Gauge 0 — Hornby Series — Gauge 0

SEND FOR COMPLETE ILLUSTRATED LIST

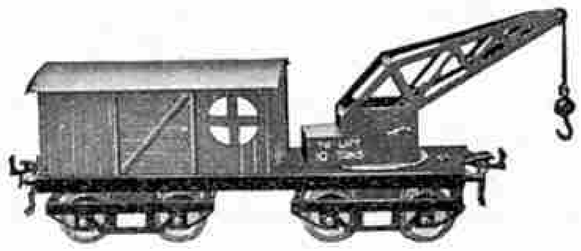
Below we illustrate 35 pieces of Rolling Stock of various types. These form part of the big range of components included in the Hornby Series. All Hornby Rolling Stock is modelled on realistic lines and is beautifully finished in colours. Each piece is available with either L.M.S., L.N.E.R. or G.W. lettering. Ask your dealer to show you the full range.



***HORNBY WAGON**
As supplied with all Hornby Goods Sets.
Price **2/6**

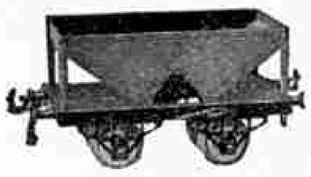


***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**

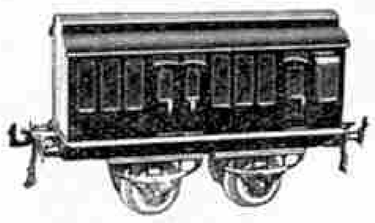


***BREAKDOWN VAN AND CRANE**
Beautifully coloured in grey and black, with opening doors. Suitable for 2-ft. radius rails only ... ... Price **6/3**

***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**

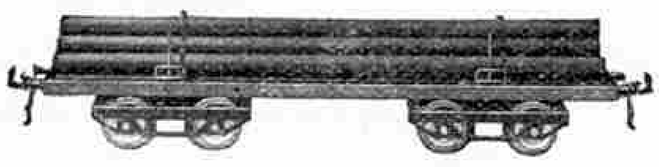


***HOPPER WAGON**
Mechanically unloaded. Finished in grey and black ... Price **4/-**



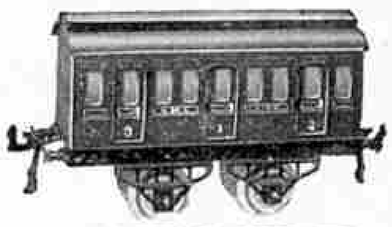
***GUARD'S VAN**
Realistic design, fitted each side with opening doors. Price **3/6**

WAGON
French type. Lettered Nord. Highly finished in colours. Price **3/3**



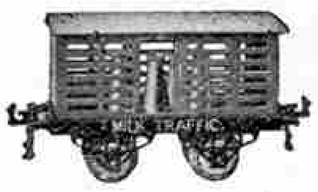
***No. 2 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only. Price **4/-**

MOTOR SPIRIT TANK WAGON "B.P."
Finished in Yellow. Price **2/6**

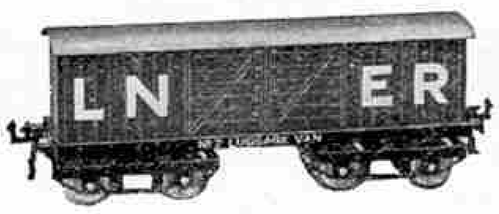


***HORNBY PASSENGER COACH**
As supplied with No. 0 and No. 1 Passenger Sets and No. 2 Tank Passenger Sets. Price **3/6**

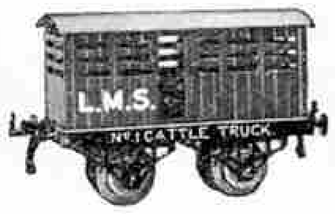
PETROL TANK WAGON "PRATTS"
Finished in green. Price **2/6**



***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans. Price **3/6**



***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **5/9**



***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design. Price **3/6**

PETROL TANK WAGON "SHELL"
Finished in red. Price **2/6**

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Finished in crimson lake, with opening doors. Price **3/6**

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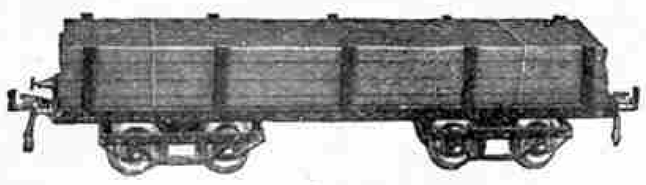
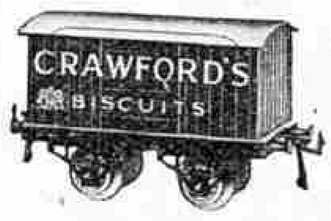
Finished in dark blue, with opening doors. Price **3/6**

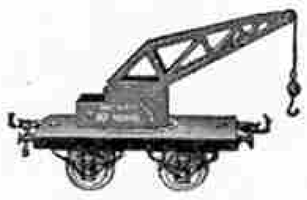


***No. 2 TIMBER WAGON**
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price **3/6**

SECCOTINE WAGON
Beautifully finished in blue, with opening doors. Price **4/-**

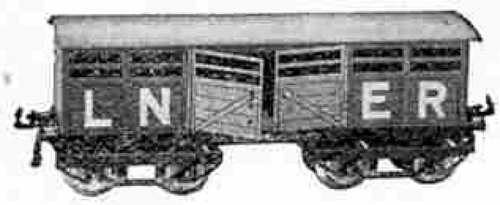


CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors. Price **3/6**



***CRANE TRUCK**
Finished in grey and black ... Price **3/6**

***No. 1 LUGGAGE VAN**
With opening doors. Price **3/6**



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Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **5/9**

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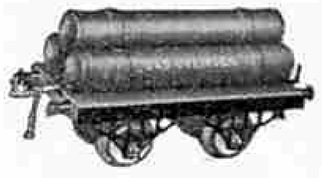
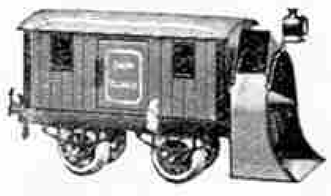
Finished in red, with opening doors. Price **3/9**



***GAS CYLINDER WAGON**
Finished in red, lettered gold. Price **2/6**



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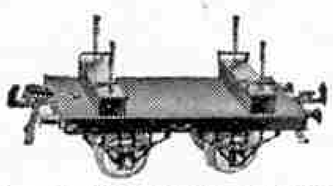
With revolving plough driven from front axle. Price **5/6**



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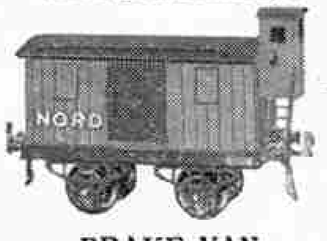

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French Type. Lettered Nord. Beautifully finished in colours. Opening doors. Price **4/-**

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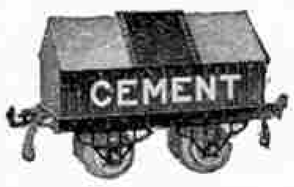
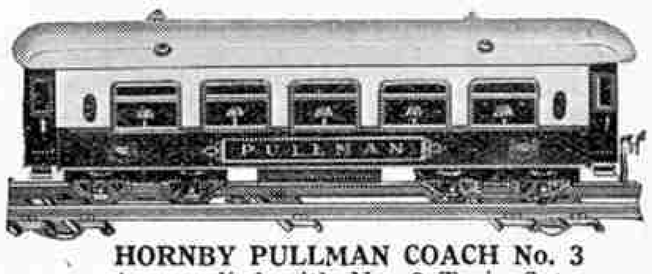
Excellent design and finish. Price **2/6**



***CEMENT WAGON**
Finished in grey and black. Price **3/-**



HORNBY PULLMAN COACH No. 3
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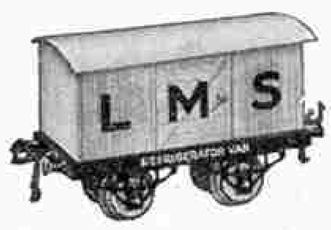

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Enamelled in white, with opening doors. Price **3/9**

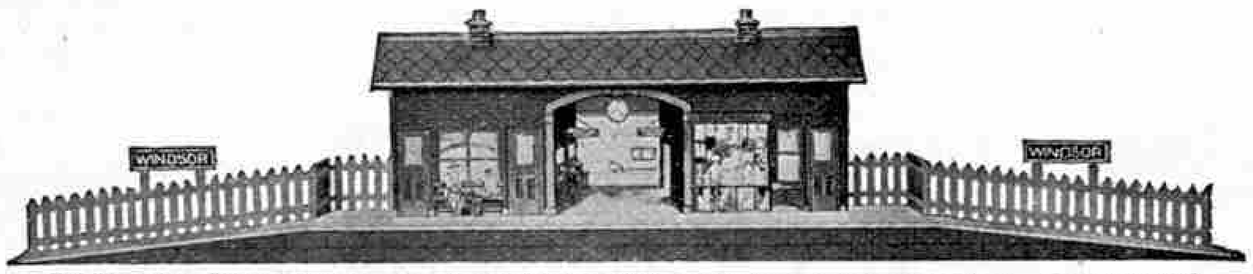
ROTARY TIPPING WAGON
Finished in grey and green. Price **3/-**

Lettered L.M.S., L.N.E.R. or G.W.

STATIONS AND ACCESSORIES

Hornby Series

The Hornby System consists of a comprehensive range of Stations, Platforms and Accessories with which the most elaborate model Railway Terminus or Goods Yard may be constructed. Every item is exceptionally well designed and is carefully modelled on its prototype in real life. A selection of the various components included in the Hornby Series of Stations and Accessories is illustrated below.

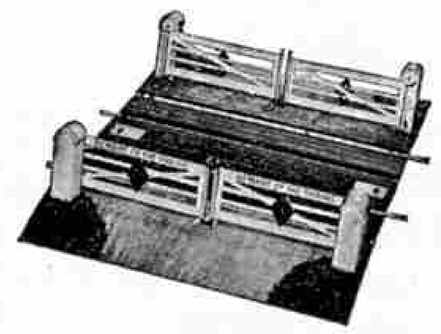


RAILWAY STATION No. 2. Excellent model, well designed and finished. Constructed in three sections which are detachable. Dimensions: Length 2-ft. 9-in., breadth 6-in., height 7-in. ... ... Price **10/–**

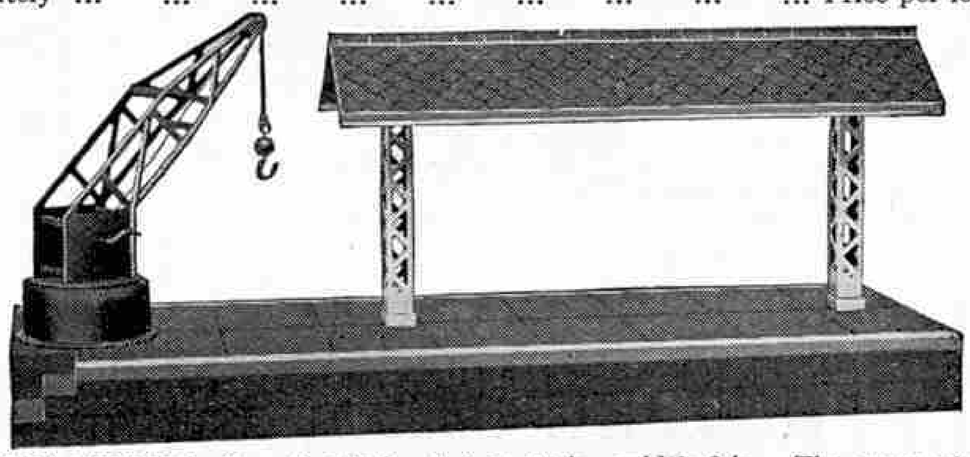
PASSENGER PLATFORM. Length 16¾-in., width 3-in. This platform may be connected to the main station or used separately. The interlocking device at each end enables a number of these platforms to be joined together ... ... Price **3/6**

White paled fencing as supplied with the Passenger Platform may also be purchased separately ... ... Price per length **6d.**

SIGNAL CABIN No. 2
Dimensions: Height 6½-in., Width 3½-in., Length 6½-in. Finished in colours and lettered "Windsor." Roof and back open to allow a signal lever frame to be fitted inside cabin, if desired, and operated ... Price **6/6**



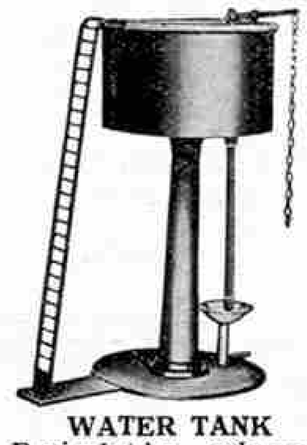
LEVEL CROSSING No. 2
Beautifully designed in colours. Measures 11½ × 7½-in. with Gauge 0 rails in position.
Price **5/–**



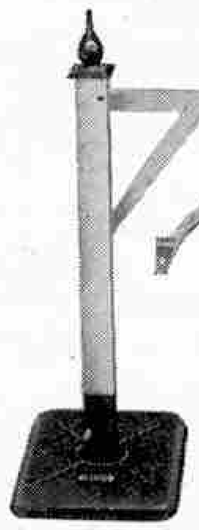
GOODS PLATFORM. Length 16¾-in., height 6¾-in., width 6-in. The crane at the end of the platform revolves on its base. It is enamelled in bright red and is fitted with a crank and ratchet mechanism for controlling the load. The remainder of the platform and shelter is coloured in green, blue and white ... ... Price **10/–**

ISLAND PLATFORM. Length 32½-in., height 6¾-in., width 3-in. The ramps at either end are detachable, and if desired the platform may be connected to the main station. Attractively coloured in green, blue and white ... ... Price **7/6**

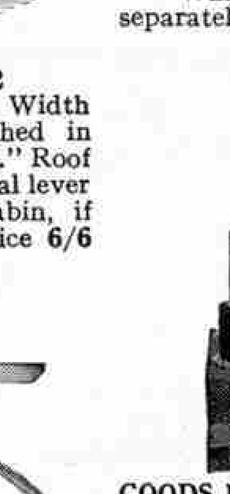
Ramps similar to those fitted to the Island Platform may be purchased separately. Price **9d.** each.



WATER TANK
Brightly coloured. Stands 8½-in. high. Fitted with flexible tube and valve lever.
Price **6/6**



LOADING GAUGE
Price **1/9**

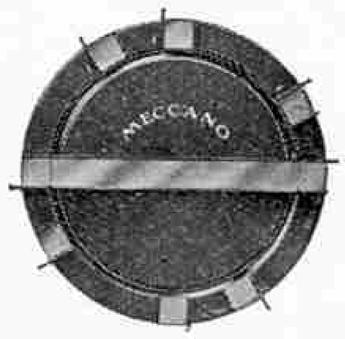


LAMP STANDARD No. 1 (SINGLE)
A 4-volt bulb may be fitted into the globe. Price **3/–**

TELEGRAPH POLE
Price per pair **3/6**

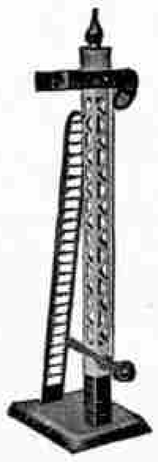
WAYSIDE STATION No. 1. A well-made model, richly finished in colours. By placing one or more of these Stations at intervals along the track, and using the Windsor Railway Station as the main terminus, a very realistic effect is given to a miniature lay-out. Dimensions: Length 16¾-in., width 6-in., height 9-in. ... ... Price **5/–**

TUNNEL
Realistic and finished in colours ... Price **7/6**

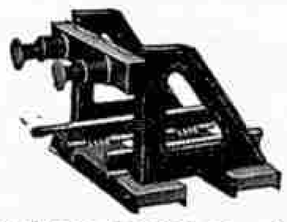


TURN-TABLE No.1 **2/6**
„ No.2 **4/–**

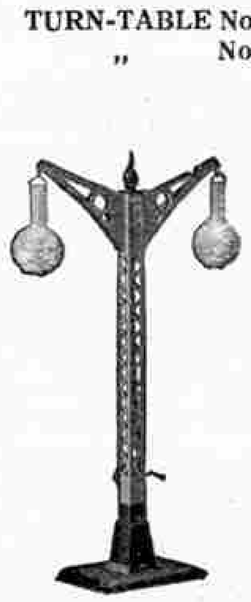
VIADUCT. Price **7/–**
ELECTRICAL VIADUCT. Price **8/–**
Centre Section for Viaduct. Price **4/6**
Centre Section for Electrical Viaduct. Price **5/–**



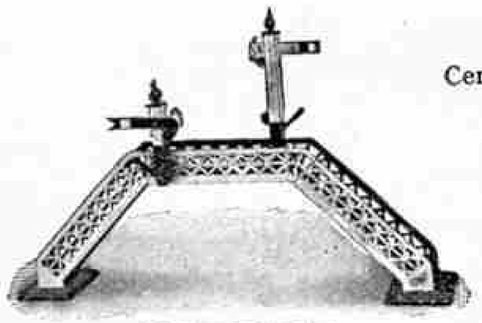
SIGNAL No.2
"Home" or "Distant."
Price **2/6**



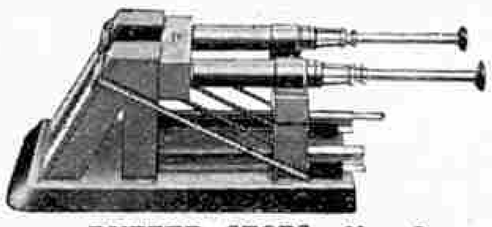
BUFFER STOPS No. 1 (SPRING)
Price **1/–**



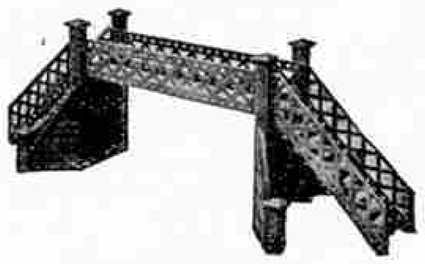
LAMP STANDARD No. 2 (DOUBLE)
Four-volt bulbs may be fitted into the globes.
Price **4/–**



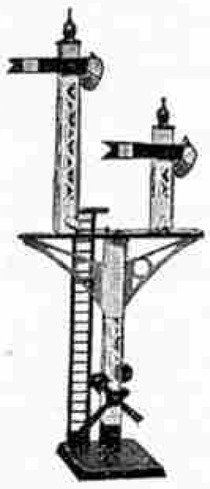
FOOTBRIDGE
No. 1. Without Signals ... „ **3/6**
No. 2. With detachable Signals Price **6/–**
Signals only ... ... per pair **2/9**



BUFFER STOPS No. 2 (HYDRAULIC) Price **5/–**



LATTICE GIRDER BRIDGE
Constructional type. Strong and well proportioned.
Price **9/6**



JUNCTION SIGNAL
Signal arms operated by levers at base. Very realistic model standing 14-in. in height.
Price **5/6**

PLATFORM ACCESSORIES
No. 1. Miniature Luggage.
Price per set **1/6**

PLATFORM ACCESSORIES
No. 3. Platform Machines, etc. Price per set **1/6**

PLATFORM ACCESSORIES
No. 2. Milk Cans and Truck.
Price per set **1/6**

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone : B'head 621 BIRKENHEAD.

HOBBIES LTD.,
9a, High Street,
BIRMINGHAM.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

BATESON'S SPORTS DEPOT,
Abingdon Street,
BLACKPOOL.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

J. MORRIS, F.C.O.,
70, Knowsley Street,
Tel. 1074 BOLTON.

BROWN, MUFF & CO. LTD.,
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HOBBIES LTD.,
68, London Road,
BRIGHTON.

JOHN TAYLOR,
28, Preston Street,
Tel. : Brighton 957 BRIGHTON.

BRISTOL TOY EXCHANGE,
92b, Whiteladies Road,
Clifton, BRISTOL.

GYLES BROS. LTD.,
Tel. 2888 24, Bridge Street, BRISTOL.
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
BRISTOL. NEWPORT.
CARDIFF. SWANSEA.

SALANSON LTD.,
20, High Street, BRISTOL.
4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 BURY.

HAROLD HUNT,
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HOBBIES LTD.,
385½, Yonge Street, Toronto 2,
CANADA.

PANTOYS LTD.,
Tel. 3561
The Promenade, CHELTENHAM SPA.
37, Westgate Street, GLOUCESTER.

THOMAS JAMES & SON,
High Street,
CINDERFORD.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

JAMES L. DIXON,
14, Suffolk Street,
Tel. Dublin 1528 (off Grafton St.), DUBLIN.

DIXON'S
41, High Street,
DUNDEE.

BASSETT-LOWKE LTD.,
5, Frederick Street,
EDINBURGH.

ROBERT BALLANTINE,
103½, St. Vincent Street,
GLASGOW.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

HOBBIES LTD.,
326, Argyle Street,
GLASGOW.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

H. POULTON, Toyland,
75 & 77, High Street,
HOUNSLOW, Middlesex.

GAMLEYS,
The Hove Hornby Train Store,
78, Church Road, HOVE.

HAMMOND'S LTD.,
Paragon Square,
HULL.

WALKER'S EMPORIUM,
25-9, Inglis St., and 11-13, New Market,
INVERNESS.

W. J. S. CARPENTER,
13 & 15, Queen Victoria Street,
LEEDS.

HOBBIES LTD.,
89a, Woodhouse Lane,
LEEDS.

PEARSON & DENHAM (PHOTO) LTD., 6, Bond Street,
LEEDS.

A. WRIGHT, The Garage,
200/2, Dewsbury Road,
Tel. 22719 LEEDS.

ROBOTHAM'S LIMITED,
"Baby's Kingdom,"
Tel. 4809 Belvoir St., LEICESTER.

LLOYD & SONS LTD.,
2, Station Street,
LEWES.

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road,
Upper Norwood, LONDON, S.E.19.

DEMPSEY & CO.,
69, South Side, CLAPHAM,
'Phone : Brixton 3022 LONDON, S.W.4.

Meccano & Hornby Train Supplies

The thirty dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HOBBIES LTD.,
65, New Oxford Street,
Tel. Mus. 1656 LONDON, W.C.

HOBBIES LTD.,
147, Bishopsgate,
Tel. London Wall 7350 LONDON, E.C.

HOBBIES LTD.,
79, Walworth Road,
Tel. Central 2457 LONDON, S.E.

LEDWITH BROS.,
42 & 44, Walworth Road,
Nr. ELEPHANT AND CASTLE, LONDON, S.E.17.

PERCIVAL & CO.,
140, High Street,
Tel. Wstw. 0120 WALTHAMSTOW, E.17.

F. R. POTTER & SON,
43, Market Place,
LOUGHBOROUGH.

H. G. PARTRIDGE & CO.,
10, Chapel Street,
Tel. 234 LUTON.

BARRS, Children's Paradise,
49, Deansgate,
Telephone 165 City MANCHESTER.

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
90, Bradshawgate, BOLTON.

HENRY'S Toy & Game Stores,
22, King Street,
Tel. 3004 Central MANCHESTER.

HOBBIES LTD.,
10a, Piccadilly,
MANCHESTER.

A. INMAN, MANCHESTER.
105, Lapwing Lane, Didsbury. Tel. 1518.
179, Dickenson Rd., Rusholme. Tel. 2241.

JOHN NESBITT LTD.,
42, Market Street,
MANCHESTER.

H. WILES LTD.,
124, Market Street,
MANCHESTER.

R. SCUPHAM & SONS,
35, Linthorpe Road,
MIDDLESBROUGH.

WILLIAM OLLIFF,
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NEWCASTLE-ON-TYNE.

BEECROFT & SONS,
16, Pelham Street,
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DEAN & HOLT,
78, Yorkshire Street,
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SALE, CHESHIRE.

HOBBIES LTD.,
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THE REDGATE CO.
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SHEFFIELD PHOTO COMPANY,
6, Norfolk Row (Fargate),
'Phone 23891 SHEFFIELD.

WILSON, GUMPERT & CO. LTD.,
57, Fargate,
Tel. 20489 SHEFFIELD.

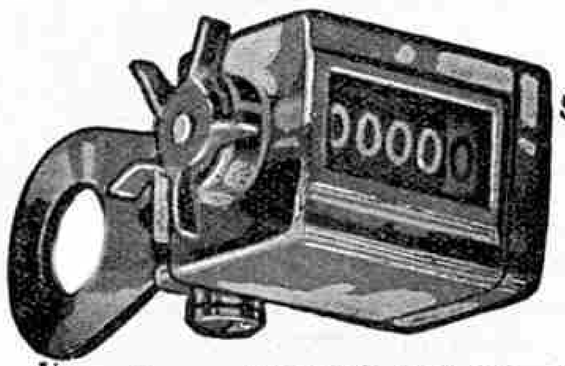
BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar,
SOUTHAMPTON.

HOBBIES LTD.,
25, Bernard Street,
SOUTHAMPTON.

S. T. SIMPSON & SON,
589-595, Lord Street,
Tel. 4998 SOUTHPORT.

H. W. GINN,
The London Motor, Cycle & Sports Co.,
Tel. 252 Staines 106, High St., STAINES.

E. M. COLLINS,
12, Lower Castle Street,
TRALEE.



A VEEDER

CYCLOMETER FITTED TO YOUR BICYCLE TELLS YOU :
How far you have been.
Distance from one place to another.
Service your tyres give you.
Number of miles to destination.
Distance travelled, etc.

Make your riding doubly interesting. Its accuracy has been endorsed by all the best authorities and the experience of your fathers for 30 years.

Insist upon a genuine Veeder—see the name thereon.

Made in Two Models :
Regular 6/6, Trip 15/-.
F. E. DICKINSON,
St. Andrew's House, Holborn Circus, E.C.1.

NEW PISTOL. LATEST INVENTION.
MAKES ITS OWN AMMUNITION.
(Patent). British Manufacture.

Breech Loading. Bolt Action.

Weight 11 ozs.
PRICE 2/6
Carriage Paid inland.

NO LICENCE REQUIRED.
G. W. GOLDRING, 1, Natal Rd., BRIGHTON.

A "Q" Pennant adds a Note of Distinction to your Meccano Model or Cycle

By arrangement with Meccano Limited, the famous "Q" pennants are now available in standard Meccano colours for use with Meccano models, size 8" × 4". Complete, as illustrated, 9d. post free.

"Q" ACCESSORIES COMPANY
1 & 2, The Arches, Kew Bridge, Chiswick, W.4
Liberal Discounts to Meccano Dealers.

ROLLER SKATES

More popular than ever.
All our Skates are extension type and adjustable to any size.

Send for a pair now. You will be delighted with them.

They make an ideal birthday gift.

No. 3 with Threaded Clamps and Case-hardened Steel Wheels ... 5/- pair
No. 5 with Best Ball-Bearing Wheels 10/- ,,
No. 6 with Best Ball-Bearing Wheels and Block Heels, as illustrated ... 11/- ,,

Postage and Packing 1/-. Colonies and Abroad 5/-

Bateson's Sports Depôt, Blackpool

The 1928
Jaeger "Meccano" Jersey

JAEGER
Pure Wool

The 1928 Jaeger "Meccano" Jersey

is made with smaller dice effect in the borders round neck, sleeves and base. It can also now be had with Knickers (with fly opening) to match, at prices quoted below.

Jersey No. BJ105

22″	24″	26″	28″	30″ Chest
7/–	7/9	8/6	9/3	10/–

Knitted Suit No. 852

20″	22″	24″	26″
13/–	14/–	15/–	16/–

Colours :—Navy with Royal Blue and Saxe border.
Mixed Grey with Red and Saxe border.
Fawn with Navy and Saxe border.
Drab with Brown and Saxe border.
Mixed Brown with Brown and Orange border.
Saxe with Navy and Light Saxe border.

Three-quarter Hose, Turnover Tops to match

3, 4	5, 6, 7	8, 9, 10
2/9	3/3	3/9

Obtainable only from Jaeger Depots and Agents.
(Write for the address of your Local Agent).

JAEGER HEAD RETAIL DEPOT : 352/54, OXFORD ST., LONDON, W.1.
WHOLESALE & SHIPPING : 95, MILTON ST., LONDON, E.C.2.

BRANCHES : AUSTRALIA—Melbourne, 234/236, Flinders Lane. Sydney, 38/44, York Street.
CANADA—Montreal, 1187, Bleury Street.

Electricity Applied to Meccano—

(*Continued from page* 597)

along the wire 11 and Rod 3, through the particular switch and brush that are in contact, and so along the wire to the lamp. The current returns through the frame of the sign to the return wire 10.

As the insulated portion of each rotating switch is twice the length of the preceding one, an interval elapses before each lamp lights up. When the last brush has made contact the entire sign is illuminated and remains so until the insulated Angle Brackets lift the brushes one after the other, thereby causing the lamps to black out in rapid sequence, commencing from the end of the sign. Thus the "M" is the last letter to go out and the first to re-appear when the mechanism again starts to spell out the sign.

It is very important that plated parts be used in all parts of the model where good electrical contact is essential, as in the case of the brushes 6 and the switches 7. The Angle Girders 12 and 13 and the upright Girders to which they are bolted should be plated also, otherwise the Lamp Holders of all the lamps will have to be connected to the wire 10 by additional lengths of wire.

This model is sure to appeal to Club Secretaries and many others on account of its simplicity, reliability, and more particularly, its capacity for attracting immediate attention! It may be set working with the certain knowledge that there is nothing to get out of order. It will continue to tell the good news that "Meccano is Engineering for Boys" until the current is switched off, or all the lamps are destroyed!

"Christmas" Competition, Overseas Section)

(*Continued from page* 599)

hull and other principal features of the battleship have been designed most carefully, but it is the minute detail in the deck fittings that is the outstanding feature of Robinson's model. The model is built to scale and it is obvious that very few details have been omitted.

The construction of typewriters in Meccano is a somewhat difficult problem, but W. Sangers has succeeded in building a most interesting model of a machine of this kind. Naturally it would be very difficult, if not impossible, to construct a model that will include all the letters of the alphabet. Sangers therefore has fitted his machine with numbers in place of letters. The model is capable of typing on to a sheet of paper placed in the machine any number from 1 to 9 in any order whatsoever—certainly a remarkable piece of model-building!

An interesting effort was the motor dump lorry entered by T. C. Walker. The model incorporates a clutch mechanism consisting of two ¾″ Contrate Wheels mounted on separate shafts. One of the wheels may be brought in or out of engagement with the other, and the teeth of the Contrates form the clutch jaws.

Just as English Meccano boys have directed their attention recently to the construction of models of the Supermarine-Napier Seaplane, so Italian boys in accordance with patriotic instincts have attempted the building of the Italian machines which, though unsuccessful, put up an excellent performance in the Schneider Trophy Race. Enzo Bernardini's model of one of the Macci Fiat Machines is designed cleverly and although small is constructed very neatly.

Edward Holder submitted as his entry a model of a power hack saw. The eccentric motion imparted to the saw guides automatically alters the position of the saw blade as the material is cut. Holder's method of constructing the "feed motion" is very ingenious and the complete model is of a high standard.

Famous Inventions—

(*continued from page* 577)

invention, but his efforts met with a discouraging reception. Later he returned to America and designed and built a submarine capable of carrying 100 men. It was 80 ft. in length, 21 ft. in width and 14 ft. in depth, and travelled so silently that it became known as the "*Mute*." Fulton died before this vessel was completed.

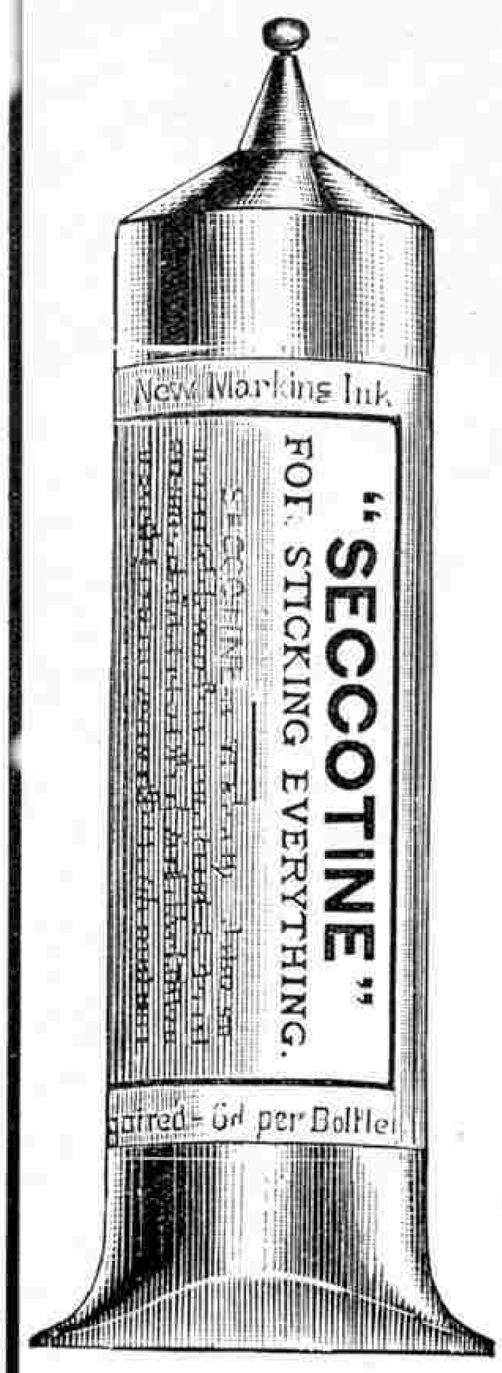
The "*Mute*" was used during the second American War of Independence and it is possible that it was the vessel that took part in the attempt to blow up the British warship "*Ramillies*," anchored off New London. The attempt was a failure, and it resulted in so great a public outcry against this method of warfare that the use of submarines was abandoned.

(*To be continued*)

MECCANO WRITING PADS

These Writing Pads are just the thing to use when writing to your friends, for the special notepaper shows at once that you are a Meccano boy.

The pads are supplied in two sizes, each consisting of 50 printed sheets of tinted bank paper with cover. Prices—Large, 1/– each (post free); Small, 6d. each (post free), from Meccano Ltd., Binns Road, Liverpool.



THE MECCANO BOY'S STAND-BY

THE TUBE OF

SECCOTINE

The World's Great Adhesive. Registered Trade Mark.

WITH it he can mend a thousand things—his bats, balls, boats, boxes, bags, books, &c. He can make numberless things that a boy likes. He can help his mother by mending breakages in house furniture, anything—everything.

NOTE. There is nothing messy about Seccotine. Use the spike or pin supplied to open a new tube—at top of cone—press gently at end of tube (at folded part) for as much adhesive as is needed—then replace spike or pin which acts as stopper. Keep folding tube end as contents are withdrawn. Give mended article adequate time for drying.

TUBES are 4½d. (vest pocket box), 6d. and 9d. each. Sold everywhere.

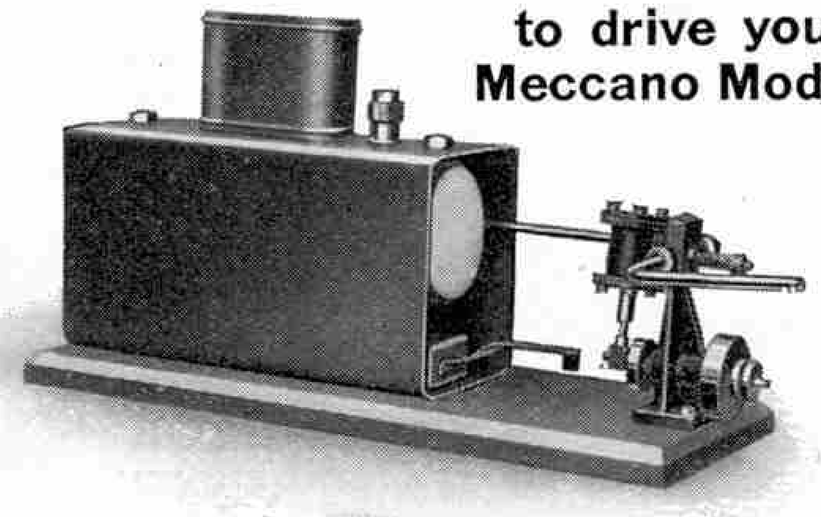
Mothers should know that cups, saucers, tumblers, etc. intended to hold liquids, hot or cold—should be mended with FIRMAS (Heat Seccotine). Tubes 6d. each.

McCAW, STEVENSON & ORR LTD.

The Linenhall Works BELFAST

You must have the S.T. ENGINE

to drive your Meccano Models



S.T. Engine Parts ... 5/– Finished Boiler ... 8/–

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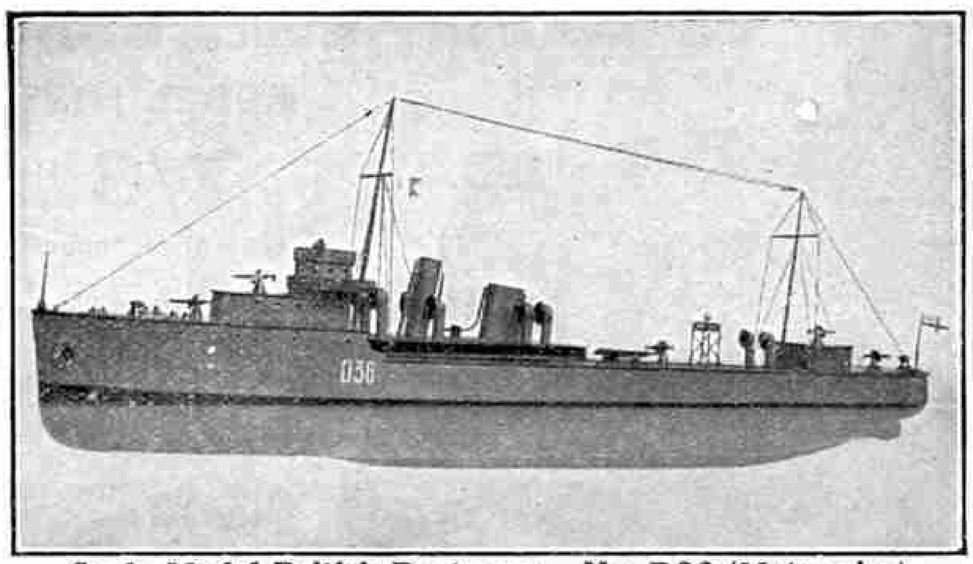

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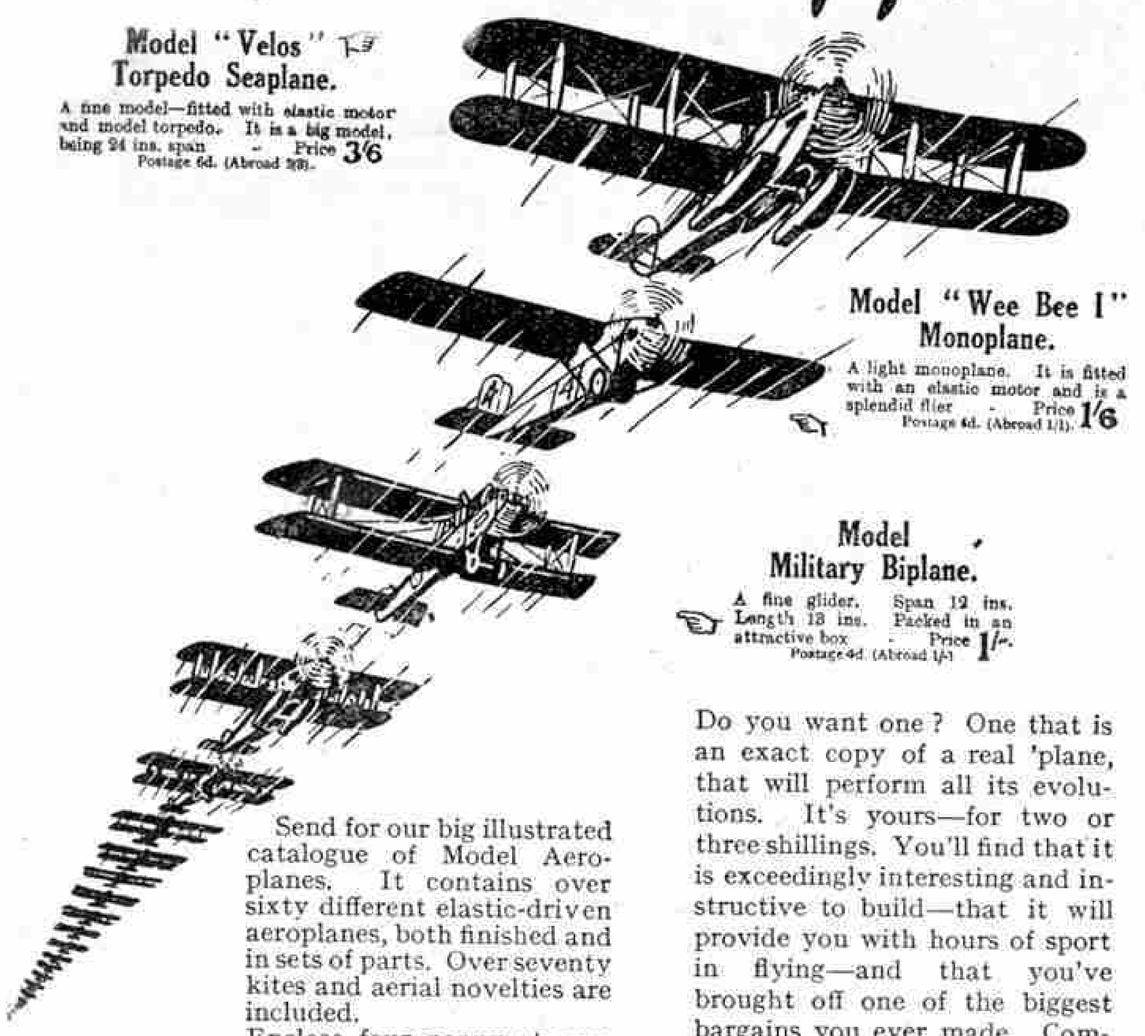

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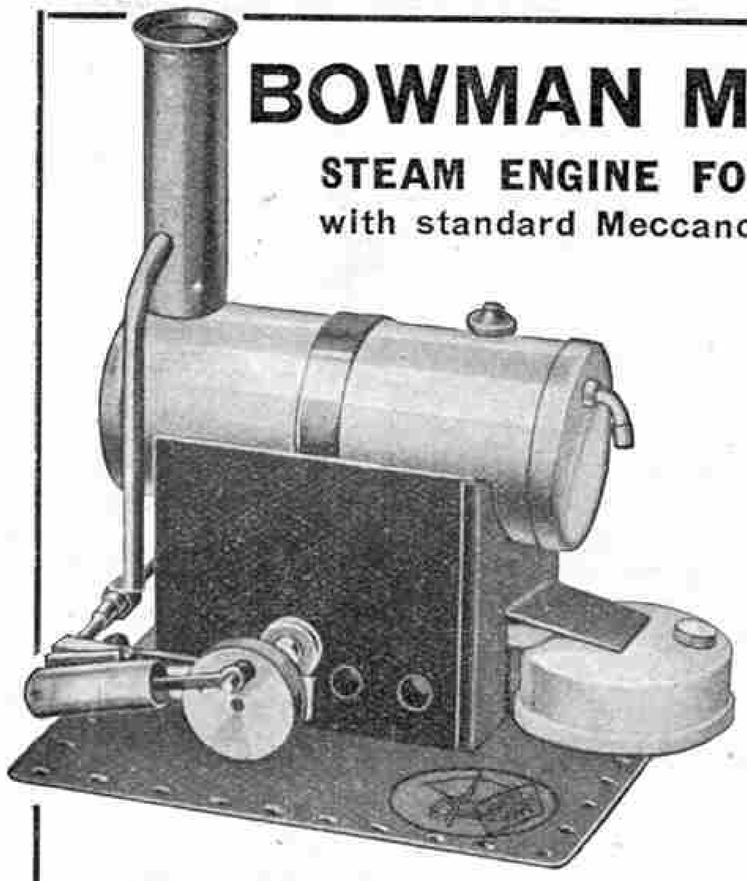

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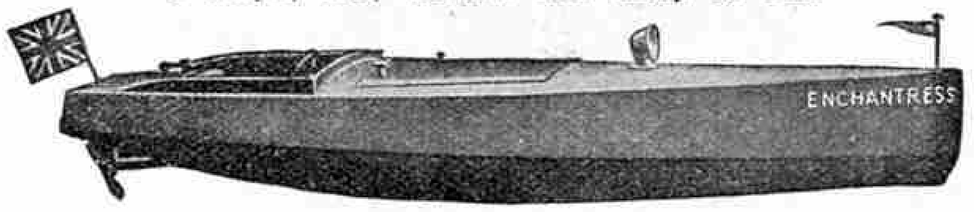

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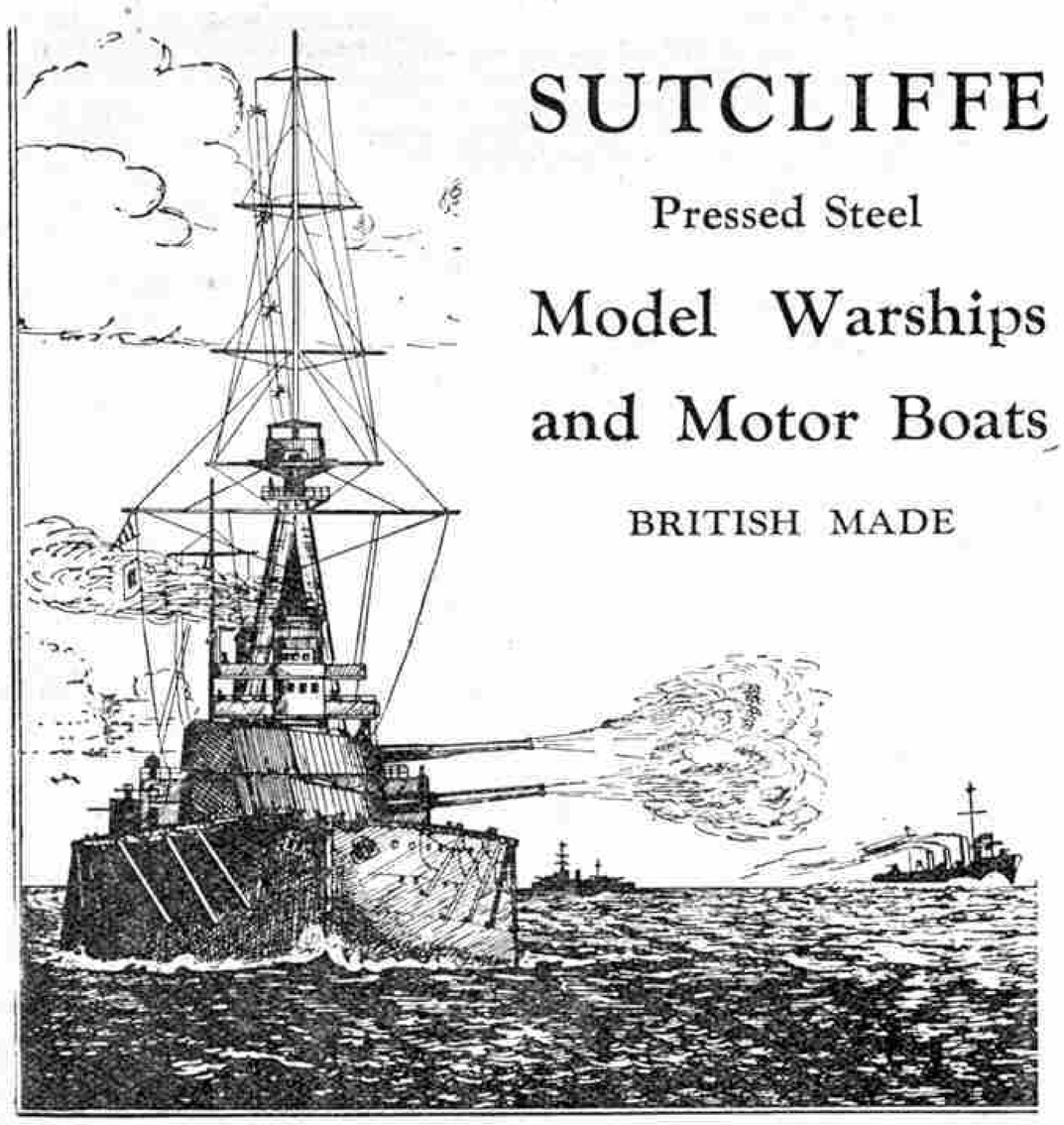

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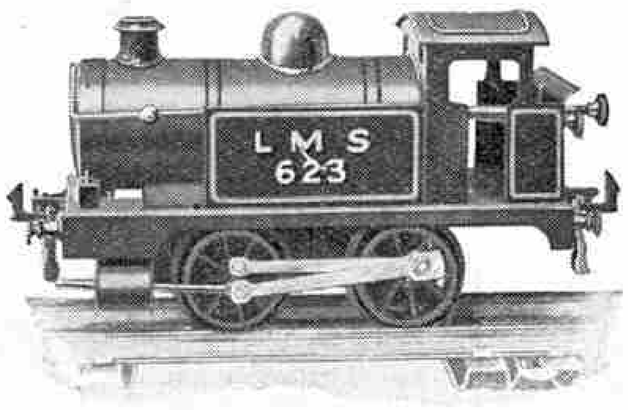

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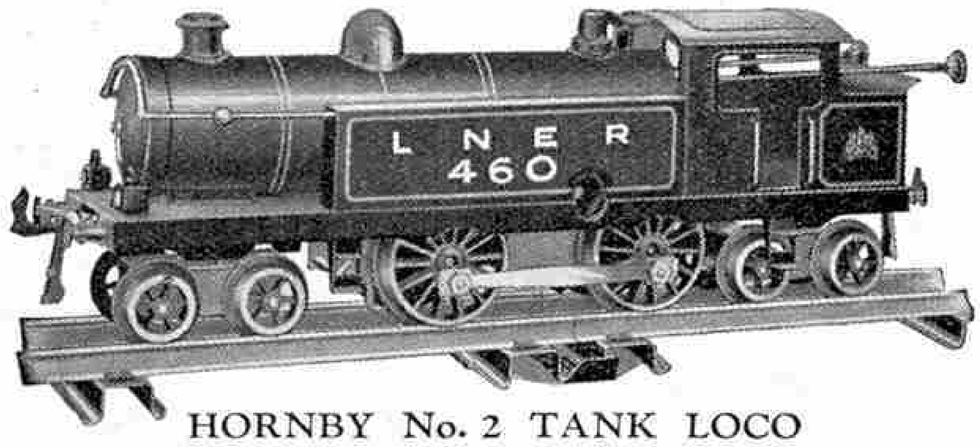

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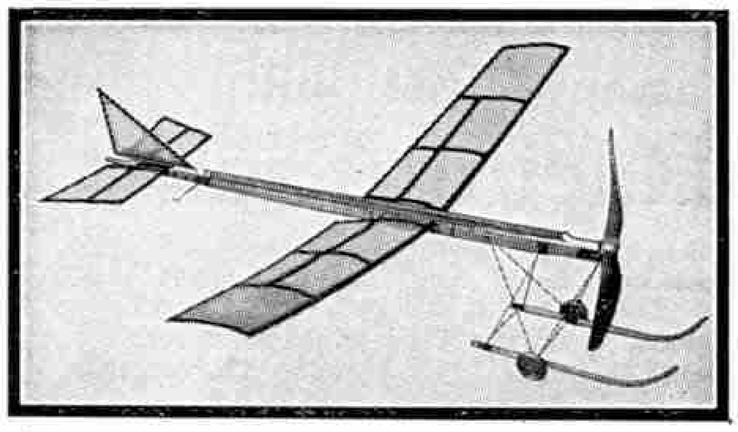

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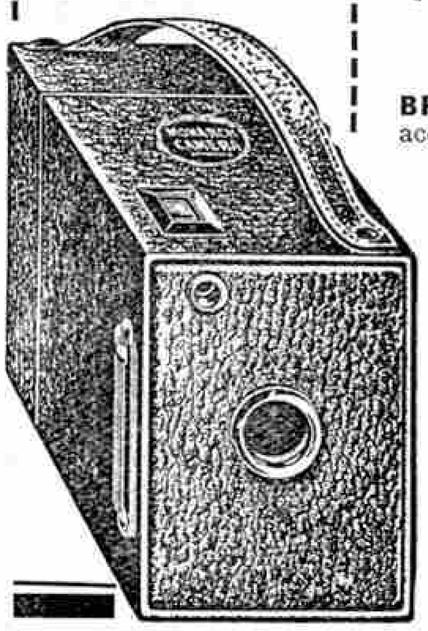

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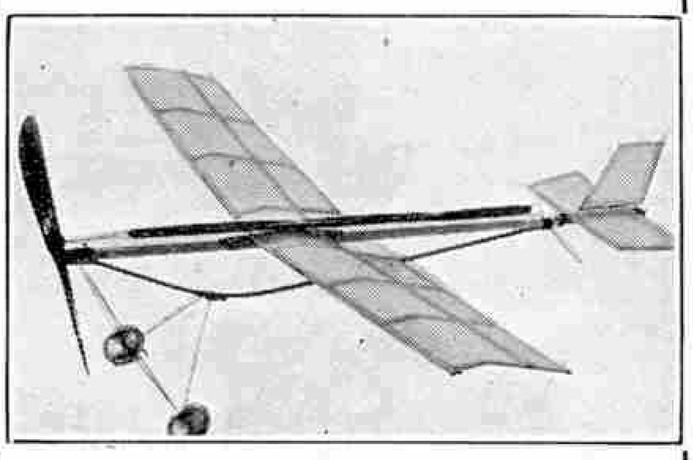

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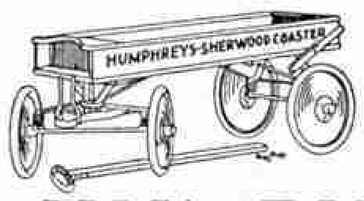

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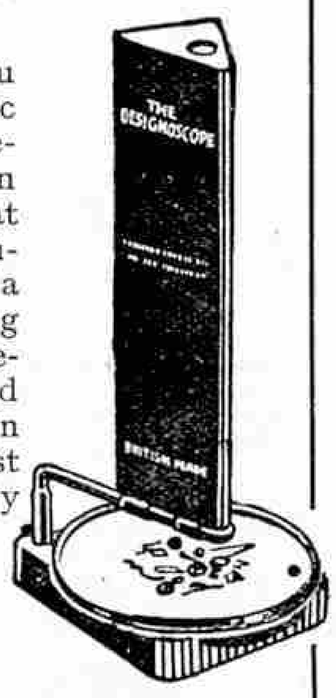

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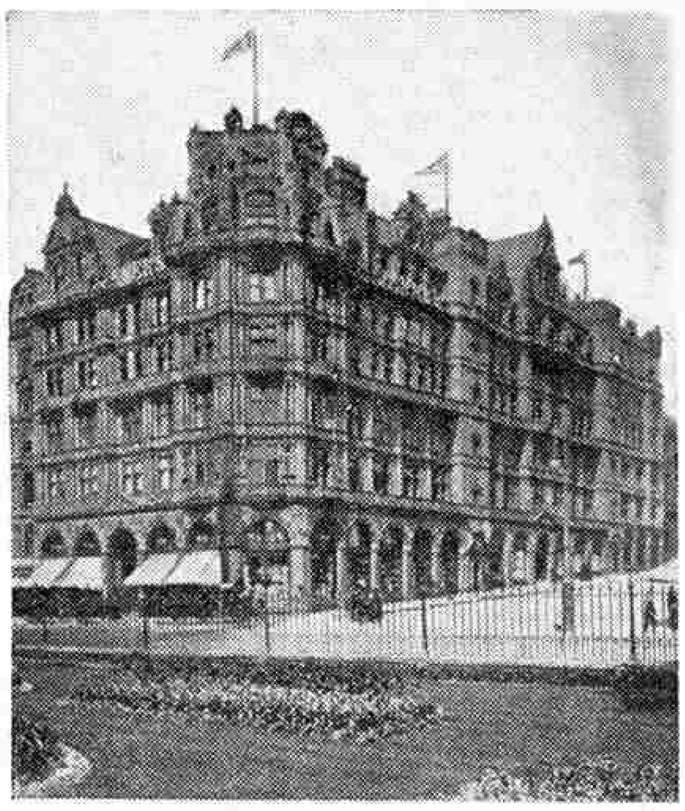

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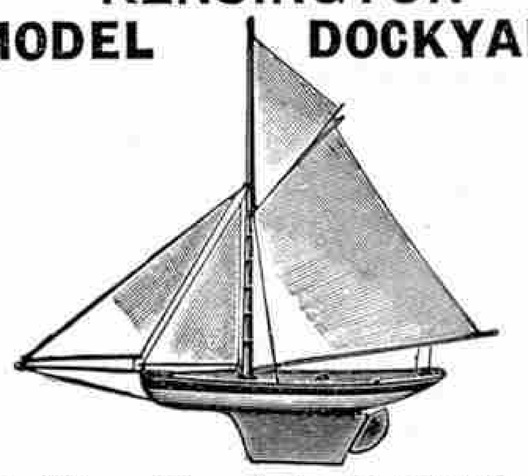

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Sale. "Lands and Peoples," Complete 36 Parts, unbound, perfectly clean, cost 45/-. Sell 15/-. Also Set Boxing Gloves, 5/-. Write—W. Turnham, 4, Greenstead Gardens, London, S.W.15.

For Sale. Cinematograph. Complete with four films, Box of Slides and Spare Lamp Globe. 10/6 or near offers.—P. G. Hill, The Broadway, St. Ives, Hunts.

Exchange Stamps.—R. Bogisch, Pt. Wakefield, South Australia.

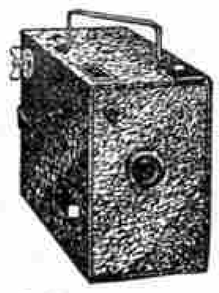
Sale. 128 Fretwork Designs, 100 Hobbies, 36 Handicrafts. Cheap. What offers?—V. Hollingworth, High Street, Westerham.

For Sale. 50 Fretwork Designs, 5/-.—G. Holmes, Bank House, Brighouse, Yorks.

Lincoln Album and 1,500 Stamps, £2. Home Cinema and Films, £3. Aquarium, 7/6. Erector Sets, 6, 5 and 3, £5 the lot. Electric Motor, 10/-. Roller Skates, 10/-. "Model Railway News," Parts 1-24, 10/-. "Wireless Weekly," Vols. 1-4, £2. Henry Greenly's "Model Railways," "Model Steam Locomotives," "Model Engineering," new, 5/-each. Three Marconi R.5 Valves, 7/6 the three. Primus Clockwork Motor, 5/-. Yacht, 30/-.—14, The Avenue, Muswell Hill, N.10.

Sale. Books, etc. Stamp for List.—Vivian, 14, Salterns Road, Parkstone, Dorset.

FILM CAMERA 4/6 (Postage 6d.)



The "**REGENT**" Film Camera. Size 4½ × 4½ × 2½ ins. Takes delightful photos, 2½ × 1⅝ ins. Fitted with convex lens, view-finder, time and instantaneous shutter, winding key, carrying handle, etc. Can be loaded and unloaded in daylight, and takes the popular vest-pocket size film, eight exposures. Illustrated booklet of instructions with each. If you wish to enjoy the delights of photography at low cost, send 5/- to-day for one of these bargain cameras. **A. HERBERTS, (Dept. G), 27, Adys Road, Peckham, LONDON, S.E.15.**

RARE STAMPS FROM COLLECTION. 40,000 Varieties. (I do not sell very cheap Stamps, nor cater for buyers of less than 4/- worth at one time). Cape Triangular Woodblocks, G.B., 1d. blacks and line engraved, 10/-, £1, £5. All old Colonial imperf. High value King's heads. Selections at ridiculously low prices (some only 1/10th Cat.), on approval against references. Useful exchange entertained. **—BOLTON OLIVET, STRETTON ROAD, ADDISCOMBE.**

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RAILWAY PHOTOGRAPHS.
New Photos, taken June:—Up "Queen of Scots" (No. 4461), Up Harrogate Exp. (No. 4471), Up Mancunian (Nos. 5985 and 6011), B'ham. Exp. (No. 4057), Continental Boat Exp. (No. 850). Real Photo Postcards, 3d. each. 12 different, 2/2 post free. New List No. 3M has 24 new titles. Free on request.
Railway Photos, 13, North John St., Liverpool.

BOYS MAKE YOUR OWN LEAD SOLDIERS
Cowboys, Indians, Animals, Zulus, Model Farmyard Sets, Rodeo, etc. Our CASTING MOULDS make thousands from any scrap lead WITHOUT PREVIOUS EXPERIENCE. Send stamp to-day for Illustrated Catalogue. Complete mould ready for work **2/6.—"TOY MOULDS," 67, Stafford Street, Birmingham.**
"Mention Meccano."

POCKET MICROSCOPES
Magnify lineally about 50 times, squares about 2,500 times. Disclose wonders of Nature invisible to naked eye. Indispensable for study of Chemistry, Botany, etc. Superior Microscope, complete with tweezers, 3 objects and 3 glass slides in case, post free **5/6**, Microscope, with 3 slides in box, post free, **2/6.—R. DILNOT (Dept. M), 125, Chiswick High Road, London, W.4.**

MAKE OR BUY A GRAMOPHONE 100% cheaper than others. Mechanical Parts of a 1st-class **RIFANCO-Phone**: Double Spring Motor, 12-in. Turntable, Swan or "S" Tone-arm, Superior Sound Box, Internal Horn or Cast Throat. Needle Cups as fitted by other firms in £10, £20 Gramophones. All bar the wood. **Nett Cash £1:18:6**
This set supplied with polished Oak or Mahogany 40 in. high Cabinet as shown, or Jacobean Pedestal. **Nett Cash £4:10:0**
Carriage paid in U.K.
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Established 24 years.
Regent Fittings Co., 78D, 120, Old St., London, E.C.1

FREE!! GIFT

The "SILKRITE" Registered SELF-FILLING FOUNTAIN PEN
Over 5,000 Testimonials received! GUARANTEED 5 YEARS' WEAR!

1/6

G. FRANCIS, Esq., writes:—"25 Pens I have purchased and all my friends are perfectly satisfied."
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With every "Silkrite" Pen at 1s. 6d. each (and 3d. extra for postage of gift) we give absolutely FREE these novel Pocket Folding OPERA GLASSES combining 6 useful instruments in ONE:—Telescope, Stereoscope, Microscope, Compass, Magnifying Glass. P.O. for 1s. 9d. ONLY secures this amazing offer of Pen and Free Gift. Send NOW!! *Write for 1928 Gift Catalogue, Richly Illustrated, full of Big Bargains, Jewellery, Fancy Goods. Post Free!*—The LEEDS BARGAIN Co. (M), 31, Kendal Lane, LEEDS.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order (see important notice below).

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Stamp Advertisers Please Note:—

The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/- per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Ordering the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 8/- for six months and 16/- for 12 months (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Ltd., Kingston & Federal Street, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Karachi: Bombay Sports Depot, Elphinstone Street.
Bombay: Bombay Sports Depot. Dhobi Talao.
Calcutta: Bombay Sports Depot, 13/C, Old Court House Street.

A MAN OF FOURTEEN! What about a job? What about Canada? You get a paid job, boarding with a farmer, working among horses and machines; and there's shooting, boating, canoeing—it's great! An Association approved by the Government looks after you until you are nineteen when you get your savings and can start on your own with the chance of borrowing £500 from the Government when you are 21. Canada's fine; write to Mr. D. M. Johnson of the Canadian National Railways (Boys' Dept.), 17, Cockspur Street, London, S.W.1, and get full particulars of FREE passages (nothing to pay back) and this wonderful opportunity. Mark your letter "Personal."

GAMAGES

will help you to make the most of this Summer!

Have you ever been to Gamages?

Well, if you haven't, make up your mind to pay us a visit—when you've been once you'll long to come again. This Great London Store is a Boy's Eldorado—Numerous Departments packed from floor to ceiling with everything apertaining to their Sports, Hobbies and Pastimes, and a thousand and one interesting novelties and attractions. If you can't come, WRITE to us about the subject in which you are interested and we will send full particulars of your wants.

MECCANO BOYS—

WE STOCK ALL HORNBY TRAINS and MECCANO PARTS and send them Carriage Paid to any Station U.K.

Chemical Outfits

A fine Hobby for the wet evenings and one of which you will not quickly tire. It is amusing, interesting, and very educational. You have a choice of a large range of outfit if you come to GAMAGES.

5/6

Other Sets **3/3, 14/6, 25/-, 52/-**

Conjuring Cabinets

Jolly fun for the wet evenings and dull days. The fellow that conjures is always welcomed wherever he goes—but only by using Gamages apparatus. Supplied in the following prices: **3/-, 7/9, 10/9, 15/9, 22/-, 35/-, 42/-, 63/-.** Post 4d.

4/6

Complete Radio Set

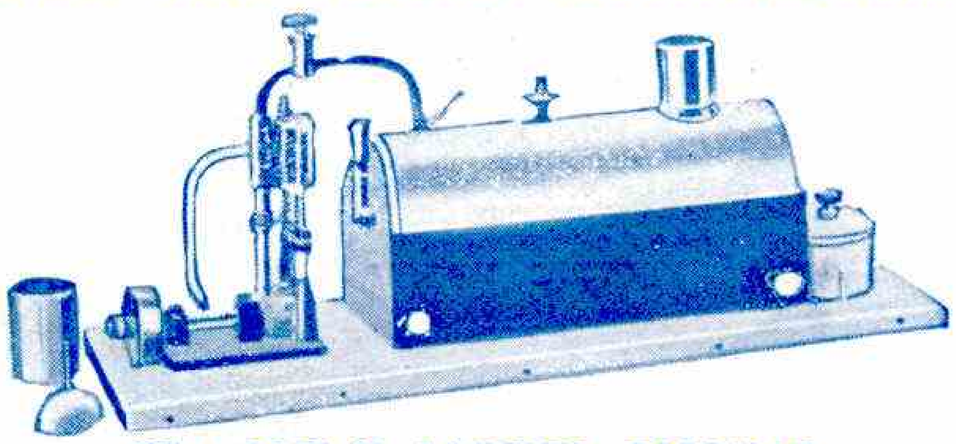
At a price you can easily afford. The World Famous Brownie Crystal Set, complete with Headphones and Aerial Outfit. The Set complete. Post free

19/6

Set only **10/6**

Special 5XX Daventry Coil for same, **2/6** extra.

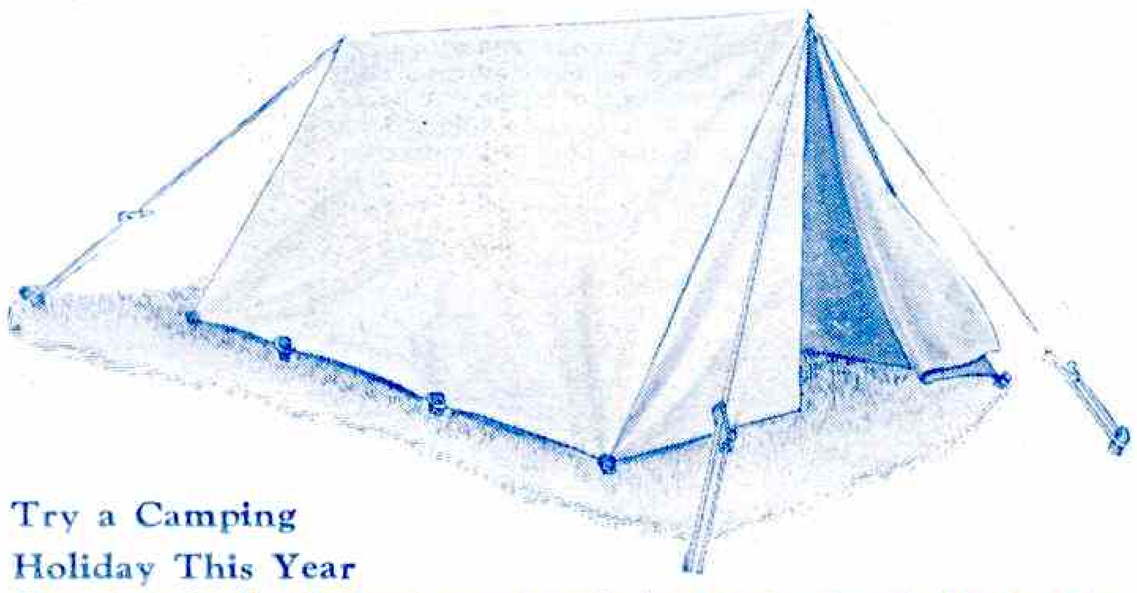
FOR THE MODEL ENTHUSIAST!



The N.D.C. MODEL ENGINE

Made from the highest grade anti-friction metal, and of a permanent silver-white polished finish, enamelled green and red. All parts interchangeable. The boiler is of a specially good "steaming" hollow form underneath, and has pressed formed heavy plate ends. The fittings include ground-in brass on brass safety valve. A beautifully made solid brass water gauge. Perfect model steam-cock control. Especially large automatic lubricator for piston valve, piston, etc. Engine double-acting cylinder, ⅝" bore and stroke, of exceptional power and efficiency. Effective three-wick lamp. Measure and fluted filler, all of polished brass. Price

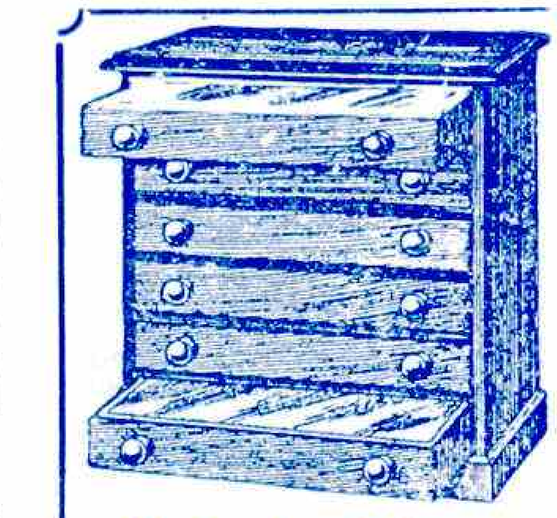
32/6



Try a Camping Holiday This Year

Think of the fine Healthy Sport you enjoy—the delights of an Open-air Life for a few weeks, but only with the correct Camping Gear. Well, of course, "GAMAGES ARE THE PEOPLE," you say. Then order this Splendid Tent right now. Made of Green Rotproof Special Lightweight Material, absolutely waterproof, Jointed Poles, Packed complete in valise including ropes, pegs, mallet, etc. Size 6×5×4. Will sleep 2 adults or 3 to 4 boys. Plain material, **26/-** Price

31/-



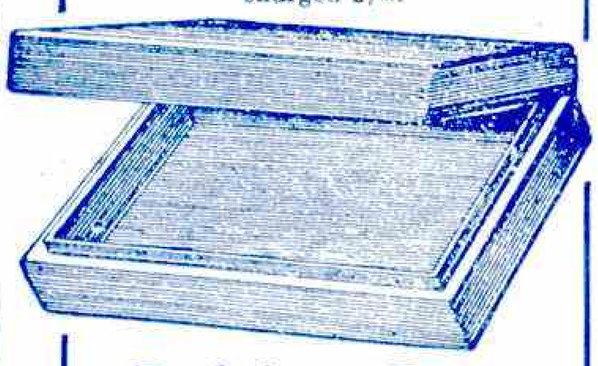
Butterfly Cabinets

Stained Deal. Drawers with sliding glass tops. Corked and papered.

Drawers	Height	Width	Depth	Price
4	13 in.	12 in.	8 in.	**25/6**
6	15 in.	16½ in.	9 in.	**33/6**
8	18 in.	22 in.	11 in.	**63/-**
10	19½ in.	27½ in.	12 in.	**90/-**

In Old Oak **32/6, 42/-, 75/-, £5 12/6**

Carriage extra. Crates (returnable) charged 2/6.



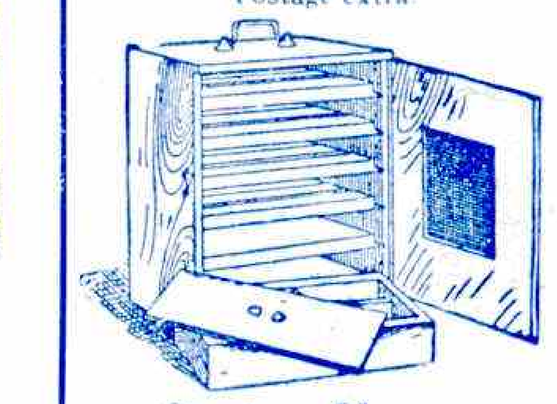
Deal Store Boxes

Corked and papered with camphor cells.

Pocket size, 6×4 in. ... **2/6**

Size		Size	
8×6 in.	**3/9**	14×10 in.	**7/3**
10×8 in.	**4/6**	16×11 in.	**8/6**
13×9 in.	**5/6**	17½×12 in.	**10/-**

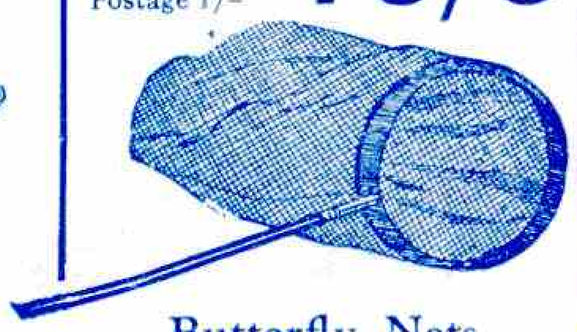
Postage extra



Setting Houses

Plain deal drying houses, with 10 corked setting boards (various sizes), drawer for pins, perforated zinc door, brass handle at top, 12×9×5 Postage 1/-

16/6



Butterfly Nets

Plain Cane Ring, with square brass fork, good net and cane handle **3/11** & **4/11**

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

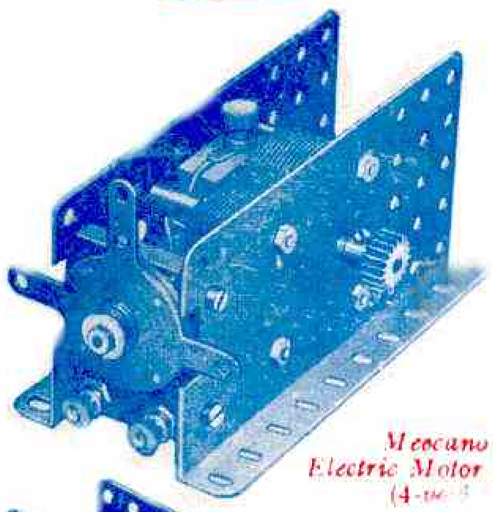
Run your Meccano models with Meccano Motors

RELIABLE — POWERFUL — SPECIALLY DESIGNED TO BUILD INTO THE MECCANO SYSTEM

If you wish to obtain the fullest possible enjoyment from the Meccano hobby you should operate your models with a Meccano Motor. Just imagine the thrill of setting in motion your Crane, Ship Coaler, Motor Car, Windmill or any other model you build. You push over the control lever of the Motor and immediately the model commences to work in exactly the same manner as its "big brother" in real life.

All Meccano Motors are strongly made and the utmost care is taken in their manufacture to ensure that they give every satisfaction to their owners.

Particulars and prices of the Motors and Accessories are given below.



Meccano Electric Motor No. 1 (4-volt)

Meccano Electric Motor No. 2 (100-250-volt A.C. or D.C.)

MECCANO CLOCKWORK MOTOR

This is a splendid piece of mechanism, simple, powerful, reliable and free from all danger. It is fitted with starting, stopping and reversing levers, and all its movements are fully explained in the instructions that accompany it. Price **7/6**

MECCANO ELECTRIC MOTOR No. 1

(4-volt)

The 4-volt Motor is specially designed to build into Meccano models. It may be run by a 4-volt accumulator or, by employing the Transformer described in the next column, from the main. Fitted with reversing motion, provided with stopping and starting controls, and the gearing is interchangeable.

Price **15/6**

MECCANO ELECTRIC MOTOR No. 2

(100-250-volt A.C. or D.C.)

This Electric Motor may be employed for any purpose for which a small motor is suitable, but it is specially adapted for driving Meccano models, into which it may be built. It is designed for connection with the electric light main—100-120-volts or 200-250-volts, alternating or direct. A 6 ft. length of flex, fitted with a plug for connection with the motor terminals and an adapter for connection with an ordinary lamp socket, is included. A suitable resistance is required when the motor is run with a 200-250-volt current, and this is supplied by connecting a 60-watt lamp in series with the motor. A board, on which are mounted a suitable lamp holder (lamp not included) and a switch, is provided separately.

Price **32/6**

Lamp board (with lamp holder and switch) Price 4/6

MECCANO RESISTANCE CONTROLLER

By employing this variable resistance the speed of the Meccano Electric Motor No. 1 (4-volt) may be regulated as desired. The controller is connected in series with the motor and accumulator, or with the motor and transformer if a transformer is used as the source of power. It will not regulate the speed of a high-voltage motor connected to the main. Price **3/6**

TRANSFORMER

By means of this transformer the Meccano Electric Motor No. 1 (4-volt) may be driven from the house supply (alternating current only). It is available for all standard supply voltages, from 100 to 250 inclusive, at all standard frequencies. The supply voltage and frequency must be specified when ordering. Price **30/-**

MECCANO ACCUMULATORS

These new and excellent types of accumulators have been adapted to drive the Meccano Electric Motor No. 1 (4-volt). They have remarkable recuperative powers, and will continue to supply current when nominally exhausted.

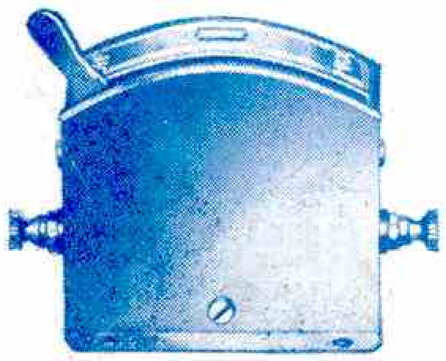
4-volt 8 amps Price **17/6** 4-volt 20 amps Price **25/-**

MECCANO RHEOSTAT

(For high voltage motors)

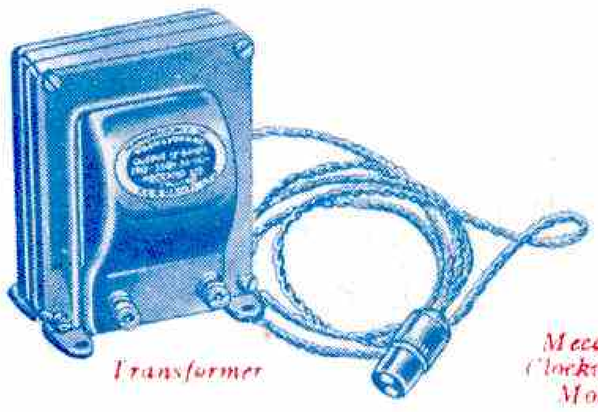
This Rheostat is for controlling the speed of the Meccano Electric Motor No. 2 or the H.V. Metropolitan Train. It may be connected to the house lighting system by means of an adapter and may be used with either alternating or direct currents ranging from 100 to 240 volts. A 60-watt lamp (not supplied) is required for use with the Rheostat.

Price **18/6**

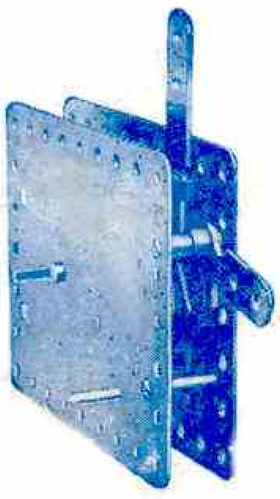


Meccano Resistance Controller

Meccano Rheostat



Transformer



Meccano Clockwork Motor

MECCANO LIMITED BINNS ROAD LIVERPOOL

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